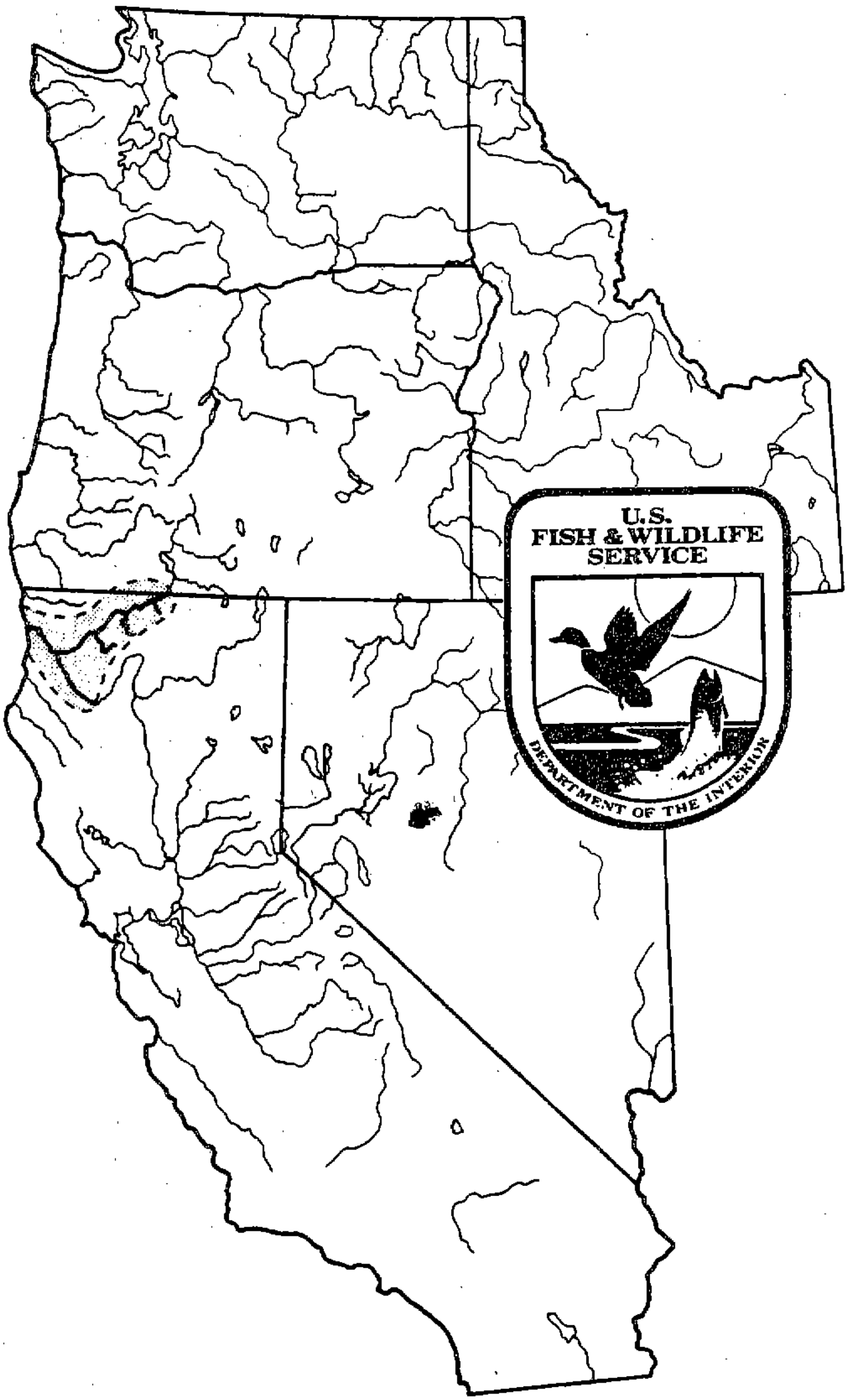
KLAMATH RIVER FISHERIES INVESTIGATION PROGRAM



ANNUAL REPORT - 1984

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KLAMATH RIVER FISHERIES INVESTIGATION PROGRAM

1984

U.S. Fish and Wildlife Service
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June 1985

THIS REPORT IS DEDICATED TO THE MEMORY OF

ROBERT J. MENDENHALL

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ANNUAL REPORT

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FORWARD

The Klamath River watershed drains approximately 40,400 sq km in Oregon and California, including about 26,000 sq km in California, most included within the boundaries of the Six Rivers, Klamath, Shasta, and Trinity National Forests (Figure 1). The Hoopa Valley Indian Reservation (HVR), comprising approximately 583 sq km in Humboldt and Del Norte counties, borders the lower 68 km of the Klamath River and lower 26 km of the Trinity River, the largest tributary in the drainage. The most important anadromous salmonid spawning tributaries in the basin include the Trinity River, draining approximately 7,690 sq km, and the Shasta, Scott, and Salmon Rivers, each draining approximately 2,070 sq km. Iron Gate Dam on the Klamath River (km 306) and Lewiston Dam on the Trinity River (km 249) represent the upper limits of anadromous salmonid migration in the basin, and hatcheries located near the base of each dam (Iron Gate and Trinity River Hatcheries) were constructed in mitigation for natural fish production losses resulting from each project.

The Klamath River basin has historically supported large runs of chinook salmon (Oncorhynchus tshawytscha) and steelhead trout (Salmo gairdneri), which have contributed considerably to subsistence, sport, and commercial fisheries in California. Generations of Indians have utilized fishing grounds in the drainage, and their fisheries for salmon, steelhead, and sturgeon have historically provided the mainstay of Indian economy in the area. Sport fishing for salmon and steelhead in the drainage may exceed 200,000 angler days annually, and Klamath River stocks may account for 30% of commercial chinook salmon landings in northern California and southern Oregon, landings which have averaged approximately 400,000 per year over the last decade. The U.S. Forest Service (USFS) estimated an annual net economic value of salmon and steelhead fisheries attributable to the Klamath River basin of $25 million, and mean annual net economic values per kilometer of chinook salmon, coho salmon (Oncorhynchus kisutch), and steelhead trout habitat in the basin of $15,500, $1,400, and $2,800, respectively. In 1980, the Department of the Interior included the Klamath and Trinity Rivers in the National Wild and Scenic Rivers System. Portions of the Klamath and Trinity Rivers are also under California state classification as Wild and Scenic Rivers.

Concern about the depletion of anadromous salmonid resources and associated habitat in the basin emerged around the turn of the century, and has accelerated in recent decades coincident with expanded logging and fishing operations, dam building activity, road construction, and other development. As in other river systems of the Pacific Northwest, chinook salmon of the Klamath River basin have experienced the continued effects of habitat degradation and over-exploitation, as reflected by declining runs in recent decades.

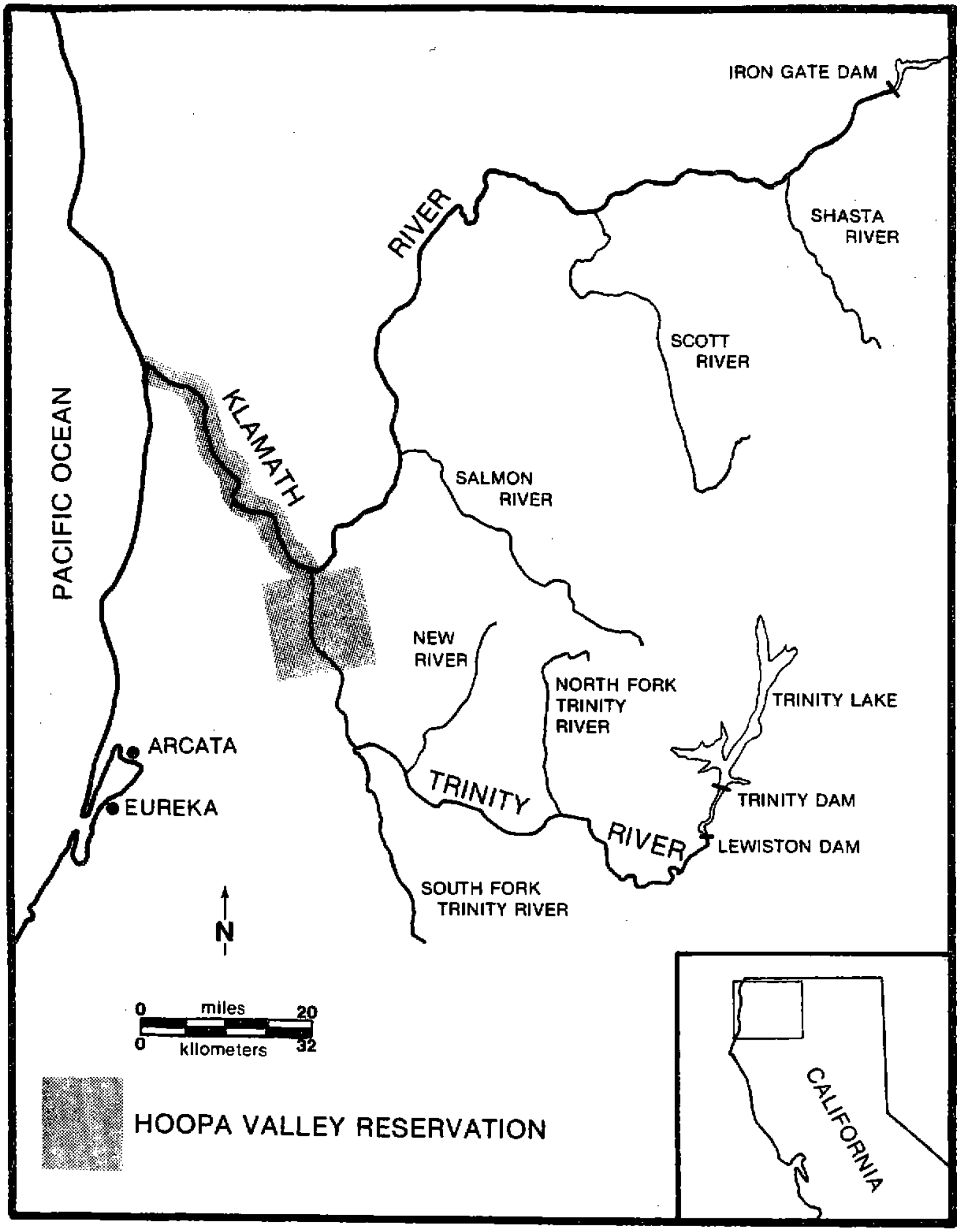


FIGURE 1. The Klamath River basin and Hoopa Valley Indian Reservation.

PLATE 1. The mouth of the Klamath River during summer of 1984.

In response to habitat problems resulting from the Trinity River Division project, the Congress enacted P.L. 98-541, the Trinity River Basin Fish and Wildlife Management Program (TRBFWMP) on October 24, 1984. This action directs the Secretary of the Interior to restore fish and wildlife populations in the Trinity basin to levels approximating those which existed immediately before the start of construction on that project.

CH_2M Hill, a consulting firm, recently completed a document entitled "Klamath River Basin Fisheries Resource Plan," (KRBFRP) through contract with the Department of the Interior, Bureau of Indian Affairs (USDI 1985). This plan details restoration actions for the remainder of the Klamath basin which are similar to those included in the TRBFWMP described above. Information from the KRBFRP could be used to prepare similar legislation to guide restoration in the remainder of the basin.

Since passage of the Fishery Conservation Management Act of 1976 and the promulgation of the first set of Federal fishing regulations governing Indian fishing on the HVR in 1977, considerable attention has also focused on the fisheries operating on the depressed chinook salmon runs, notably the ocean troll fisheries and the Indian gill net fishery on the Klamath and Trinity Rivers.

The U.S. Fish and Wildlife Service (USFWS) has ranked anadromous salmonid problems of the Klamath River basin number 18 of 78 "Important Resource Problems" (IRP's) in the United States (USFWS 1980). The Assistant Secretaries of Indian Affairs and Fish, Wildlife, and Parks, in addressing Departmental resource and Indian Trust responsibilities concerning the Klamath River basin resource and Hoopa Valley Reservation, have entered into annual fiscal memoranda of agreement (MOA) providing for fisheries investigation programs focusing on the monitoring and evaluation of chinook salmon runs in the Klamath River, and the monitoring of Indian net harvest levels on the HVR. This is the sixth in a series of annual reports covering the Klamath River Fisheries Investigation Program, conducted through the Fisheries Assistance Office, Arcata, California (FAO-Arcata) under the Fiscal Year 1984 MOA.

The program consists of five major groupings of related activities:

(1) Beach Seining Operations focus on:

(a) development of a model for annual estimation of fall chinook run size on an in-season basis, and;

(b) the annual monitoring of fall chinook runs to evaluate natural/hatchery composition, to assess hook scarring and gill net marking incidences, to collect age-growth, length-frequency and length-weight data, and to provide data on run timing and migration patterns by external tag application.

(2) Harvest Monitoring and Evaluation Efforts focus on:

(a) the annual estimation of Indian net harvest levels on the Hoopa Valley Reservation involving chinook salmon (spring and fall runs), steelhead trout (fall run), coho salmon, green sturgeon (*Acipenser transmontanus*), and;

(b) the annual monitoring of chinook and coho salmon, steelhead trout, and green sturgeon runs to evaluate natural/hatchery composition, to assess length-frequency, age-growth, and length-weight relationships within the harvest and to collect run-timing and migration pattern data by recovery of tags placed during beach seining operations.

(3) Coded-Wire Tag Analyses involve the collection and reading of coded-wire tags recovered from the net fishery during harvest monitoring activities and use of this data in statistical evaluation of the various tagged release groups through their occurrence in the ocean and in-river net fisheries.

(4) Scale Analyses involve the mounting and interpretation of chinook salmon scales obtained through the beach seining and net harvest monitoring programs to assess age, growth and racial compositions of the runs.

(5) Program-Planning, Direction, and Coordination involves keeping abreast of program planning and direction in conjunction with guidance received from the USFWS and Interior Department, annual budgeting and other administrative functions, coordinating the program with and disseminating data to a variety of concerned agencies, interest groups, and the general public.

Methods utilized and results obtained during 1984 through these program activities are detailed in sections summarizing data collected on chinook salmon, coho salmon, steelhead trout, and sturgeon. Abstracts covering the primary points precede each of the major sections of this report. While previous annual reports through 1981 have included sections detailing information on juvenile salmonid investigations within the basin, no such data is available for 1984 since budget constraints precluded field activities involving juvenile salmon and steelhead. During 1983 the Hoopa Valley Business Council Fisheries Department assumed responsibility for harvest monitoring programs covering the Trinity River portion of the HVR, formerly a part of FAO-Arcata responsibilities. This responsibility remained with the Hoopa Tribe during 1984. It should, therefore, be realized that harvest data presented in this report, unless otherwise noted, are not strictly comparable with harvest data presented in previous reports since the area of coverage has changed as described.

CHINOOK SALMON INVESTIGATIONS

ABSTRACT

A total of 3,914 chinook salmon, including 376 jacks, were captured during 1984 seining operations in the Klamath River estuary. Scales were collected from 950 chinook for age analysis. Tags were applied to 1,007 chinook for mark recapture analysis. Adipose fin-clipped chinook comprised 7.6% of the sample, and 0.67% and 22.6% of the chinook examined exhibited gill net marks and hook scars, respectively.

Age analysis from scale samples and coded-wire tag (CWT) recoveries indicates the dominance of 4-year-olds in 1984. The percentage of age 2 fish returning (13.0) is similar to that observed in 1983, the lowest 2-year-old contribution in the 6-year data base.

Gill net harvest on the Klamath River portion of the Hoopa Valley Reservation during 1984 is estimated at 17,815 fall and 259 spring chinook. These harvests represent a 169% increase in the fall chinook fishery and a 50% decrease in the spring chinook fishery from respective 1983 levels.

A total of 93 CWT, representing 17 fall and 3 spring chinook release groups, were recovered during mark sampling of the 1984 net fisheries on the Klamath River portion of the Hoopa Valley Reservation. These recoveries expand to a total estimated harvest of 702 CWT fall and 49 CWT spring chinook in the 1984 net fisheries. In-river net and preliminary ocean troll CWT return data suggest an overall ratio of ocean landings to Klamath River net harvest for CWT Klamath River basin fall chinook of 1.7:1 in 1984, the lowest ratio in the 5 years that CWT have been recovered from the in-river net fishery.

An estimated 4.0 Klamath River fall chinook were harvested through the combined ocean and river fisheries for each one spawning in the basin since 1978. The ratio between ocean harvest and river returns during the 1978-1984 period is estimated at 2.3:1.

A discussion of "El Niño", its impacts on the Klamath River fall chinook population and pertinent data observed during 1984 concerning the recovery of growth rate and size at age is presented.

BEACH SEINING PROGRAM

INTRODUCTION

A beach seining program was initiated by FAO-Arcata biologists in 1979 with the intent of evaluating potential for developing in-season and post-season run size estimates utilizing catch/effort and mark-recapture techniques and to collect biological data on fall chinook salmon. Problems encountered during the 1980 season in satisfying the requirements of mark-recapture methodology resulted in the discontinuation of the mark-recapture post-season population estimation program and the refocusing of direction to emphasize the catch/effort in-season and biological data portions of the program. At present, this program provides the only available estimates of age composition in the total Klamath River fall chinook spawning run. These data have proven valuable in estimating ocean stock size of 3- and 4-year-old Klamath River fall chinook, and therefore in management of the ocean fisheries. The 1984 season marks the sixth consecutive year of beach seine sampling of fall chinook salmon near the mouth of the Klamath River.

METHODS

Beach seining operations were conducted on the south spit of the Klamath River estuary from July 17 to September 28, 1984 (Figure 2). An estuarine site was again chosen in an attempt to sample the fall chinook run prior to impacts of the various size-selective, in-river fisheries and to provide data comparability with the 1979-1983 seasons. Site selection within the estuary was based on previous observations which indicated that fall chinook tend to migrate through the deep channel of cool, highly saline water adjacent to the south spit, and on depth profile data collected to locate this channel during a July 1984 hydro-acoustic survey (Figure 2).

Methods utilized in 1984 were similar to those of previous years. Seining was conducted 5 days per week during daylight hours by a 5-to-10 person crew of biologists and technicians. A 150 m long by 6 m deep seine of 8.9 cm stretch mesh was set from a Valco river boat and retrieved using gas powered winches.

Once crowded, fish were transferred into holding cages and then individually examined in a padded cradle for tags, fin-clips, hook scars, gill-net marks and other distinguishing characteristics. Close examination of fish for hook scars and gill-net markings is part of a continuing effort to collect information on fisheries impacts on the Klamath River chinook salmon populations. Identified wounds, scars, and marks were classified as described in Table 1. Detailed observations were recorded in conjunction with length frequency information on specially prepared data forms. All salmonids were measured to the nearest centimeter fork length and each chinook salmon received a 9.5 mm (3/8 inch) or 6.4 mm (1/4 inch) hole punch placed in the upper caudal lobe for recapture identification. In addition, a numbered aluminum or monel-metal band was applied to the left mandible of every other chinook throughout the sampling season for evaluation of

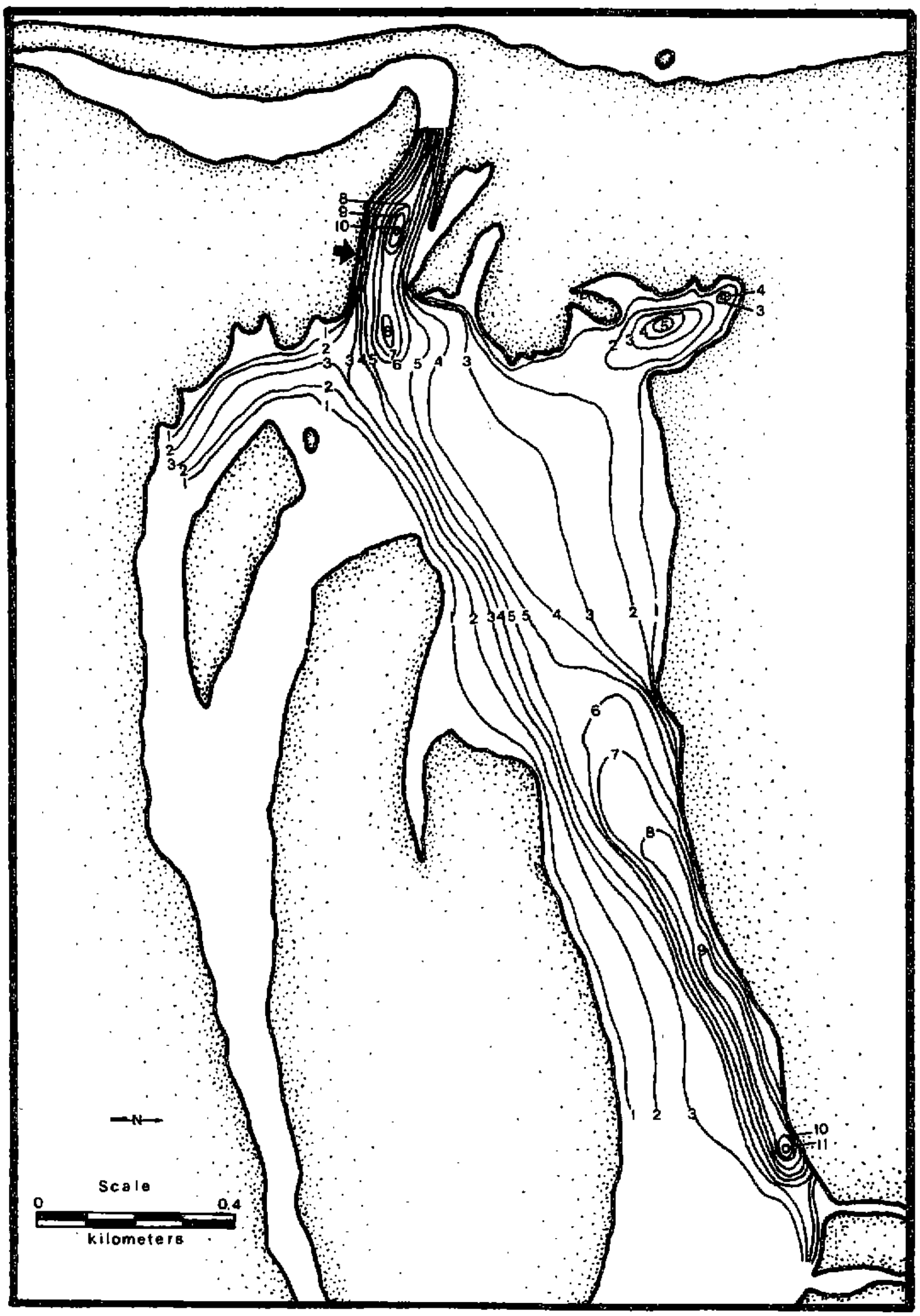


FIGURE 2. Depth contours (expressed in meters below mean high tide) of the Klamath River estuary during July 1984. Arrow depicts beach seining site.

TABLE 1. Categorization of hook scars observed during 1984 beach seining operations in the Klamath River estuary.

Characteristic	Classification	Criteria for Classification
Freshness	Fresh	Open wound, whether bleeding or not. No substantial healing exhibited.
	Healed	Completely healed scar, or open wound exhibiting a state of near total healing.
Severity	Minor	Obvious wound or scar, but not extensive or deep.
	Moderate	Extensive or deep wound or scar. Major vital structures intact.
	Major	Extensive or deep wound or scar. Vital structures missing or shredded. Debilitating damage (e.g. blindness).
Location	Upper Jaw Lower Jaw Eye and Orbit Opercle Isthmus All Other Head Areas	

migration patterns. Scale samples were taken as in previous years for age analysis. Plates 2 and 3 show the crowding and examination of fish captured in 1984 beach seining operations.

Large numbers of fish (>50) in several sets necessitated subsampling to minimize handling time and reduce stress to fish sampled. Fish not examined were identified as to species and size class (i.e., jack, adult) prior to release, for inclusion in catch/effort data. Statistical tests were conducted on data from the partially sampled sets to insure that their inclusion would not bias data presented herein.

Beach seine catch/effort data were treated in an attempt to derive indices for use in predicting in-river population abundance on an in-season basis. Methods utilized in past years in indexing beach seine catch/effort data for in-season abundance estimates have been detailed in past annual reports (USFWS 1982a, 1983, 1984). In 1984, a new indexing method was explored in order to check and/or improve the accuracy of the former run-strength index. Numbers of chinook salmon per seine haul (catch/effort) were plotted daily against time for the peak three sets during the run peak periods of 1980-1984. The area under the curve was then calculated geometrically as the sum of a series of successive trapezoids. For 1984, with a run peak period from July 27 to September 7:

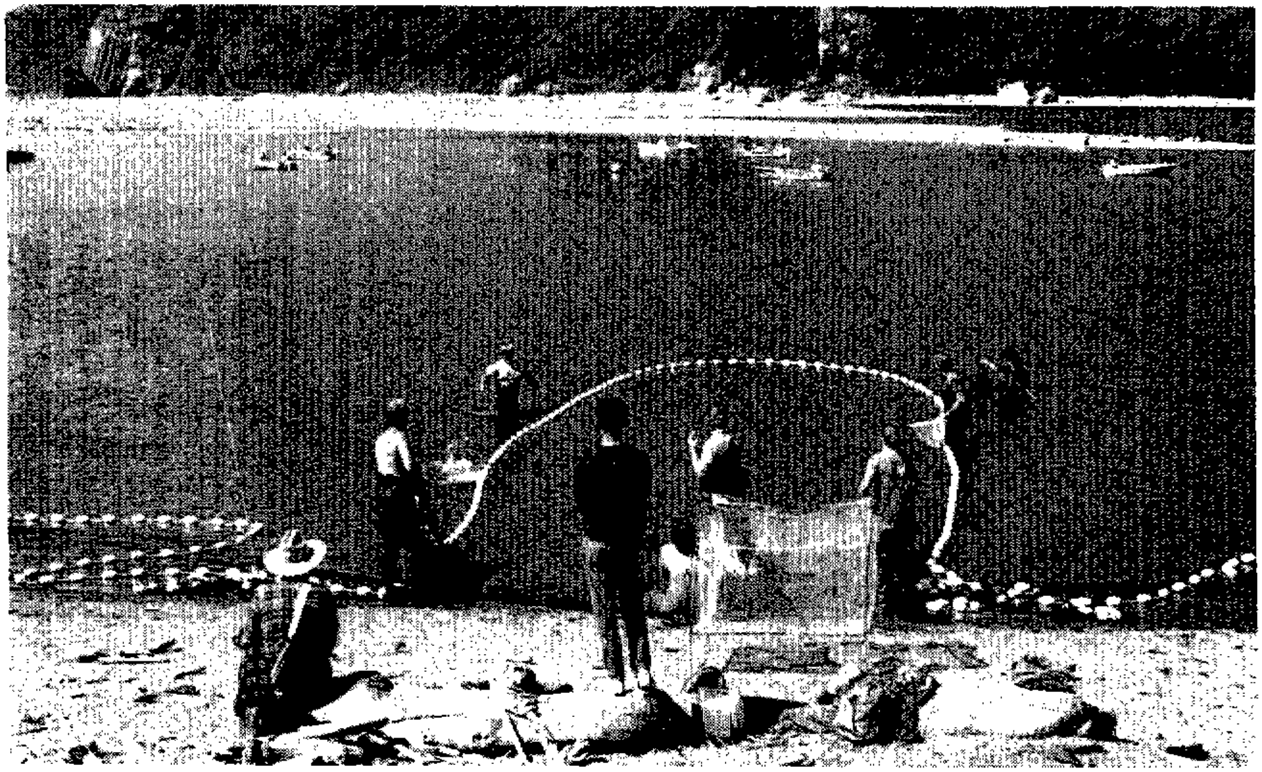
$$\text{Area} = \sum_{09/07}^{07/27} 1/2\ h\ (a + b)$$

where: h is the distance between successive sample days (data points) and a and b are the actual catch/effort values of the two successive days respectively.

This area index was developed in an attempt to check and potentially improve the accuracy of the predictor. However, comparisons of the new method with the run strength index used in the past showed no appreciable difference in the significance of respective regression equations. For this reason, and because the former method was considerably easier to calculate, the previously derived run strength index was again utilized instead of the area calculation method for the regression calculations in 1984.

RESULTS AND DISCUSSION

A total of 3,914 chinook salmon were captured in 313 seine hauls during 1984 operations, of which 2,101 (53.7%) were examined. Jacks (<53 cm) accounted for 9.6% of all chinook captured. Data from 4 of 47 subsampled sets (177 of 710 chinook) were discarded from length-frequency analysis due to a significantly disproportionate jack-adult ratio of chinook sampled versus chinook captured (chi-square analysis, $p < 0.05$). Two additional sets (13 chinook) were also discarded from length-frequency analysis, due to a torn net in one case and the concomitant capture of a large school of American shad in the other, resulting in biased chinook sample data in both



PLATES 2 and 3. The crowding (above) and examination (below) of chinook captured through 1984 beach seining operations in the Klamath River estuary.

cases (chi-square, $p < 0.05$). Data from the remaining 41 subsampled sets were included as no bias was apparent (chi-square, $p > 0.05$). All fish from the remaining 266 sets were examined.

A shift in the length-frequency distribution of adults from 1983 to 1984 appears to be the result of two main factors. First, mean lengths of jacks and adults in 1984, 45.5 cm and 68.3 cm respectively, were significantly greater than those in 1983, 41.1 cm and 64.9 cm (t-test; $p < 0.05$, Figure 3). Normal ocean growth conditions prevailed in 1984 and fish growth, adversely affected by the 1983 El Niño, apparently recovered to a certain extent. Secondly, 4-year-old fish dominated the 1984 run (44.9%), while 3-year-olds comprised the greatest proportion of the 1983 run (54.3%). For a detailed analysis of age class length frequencies, refer to the Age Composition section.

Adipose fin-clips representing various hatchery coded-wire tag (CWT) release groups occurred on 38 of 246 jacks (15.5%) and 159 of 1,855 adults (8.6%) examined. Mean length of adipose fin-clipped adults, 67.3 cm, differed significantly from non-adipose clipped adults, 68.4 cm (t-test; $p < 0.05$, Figure 4). This difference in lengths may be due to differences in maturity schedules between hatchery and natural stocks. Mean lengths of adipose-clipped jacks, 46.2 cm, did not differ significantly from non-adipose-clipped jacks, 45.4 cm ($p > 0.05$, Figure 4). Of other fin-clips observed, 1 (0.4%) jack and 45 (2.4%) adults exhibited right ventral (RV) clips, while 7 (2.9%) jacks and 136 (7.3%) adults exhibited left ventral (LV) clips.

RV and LV fin-clipped chinook represent a constant fractional marking program which was initiated in 1979 to assist in estimation of the proportional contribution of hatchery fish to production within the basin, and ultimately to assist in escapement estimation. Complete marking, however, did not occur until 1980. Therefore, only data from 1980 brood and subsequent releases is fully useable for generating estimates. As a result, 1984 was the first year that fully comparable data on 2-, 3-, and 4-year-old age components were available for use in the program. This was also a pivotal year in the constant fractional marking program as it appears that the USFWS beach seine sample size was sufficient for the first time to allow a statistically significant analysis of hatchery/natural production proportions in the run, according to methods developed by Hankin (1982). This year may represent the only opportunity to utilize such data as the constant fractional marking program at the basin's state-run hatcheries has been discontinued. A detailed analysis of beach seine constant fractional marking data and estimation of the proportions of hatchery and naturally produced fall chinook salmon in the 1984 spawning run is currently planned as the subject of a special report.

The constant fractional marking program also allows differentiation of fish by hatchery origin, LV representing Iron Gate Hatchery (IGH) and RV representing Trinity River Hatchery (TRH). In 1984, as in 1983 and 1982, an apparent behavior difference was noted between RV and LV fish with respect to timing of river entry. A greater percentage of sampled LV fish (70.9%) entered on or before August 24, while the majority of sampled RV fish (69.6%) entered after this date (Figure 5). For the third consecutive year, then,

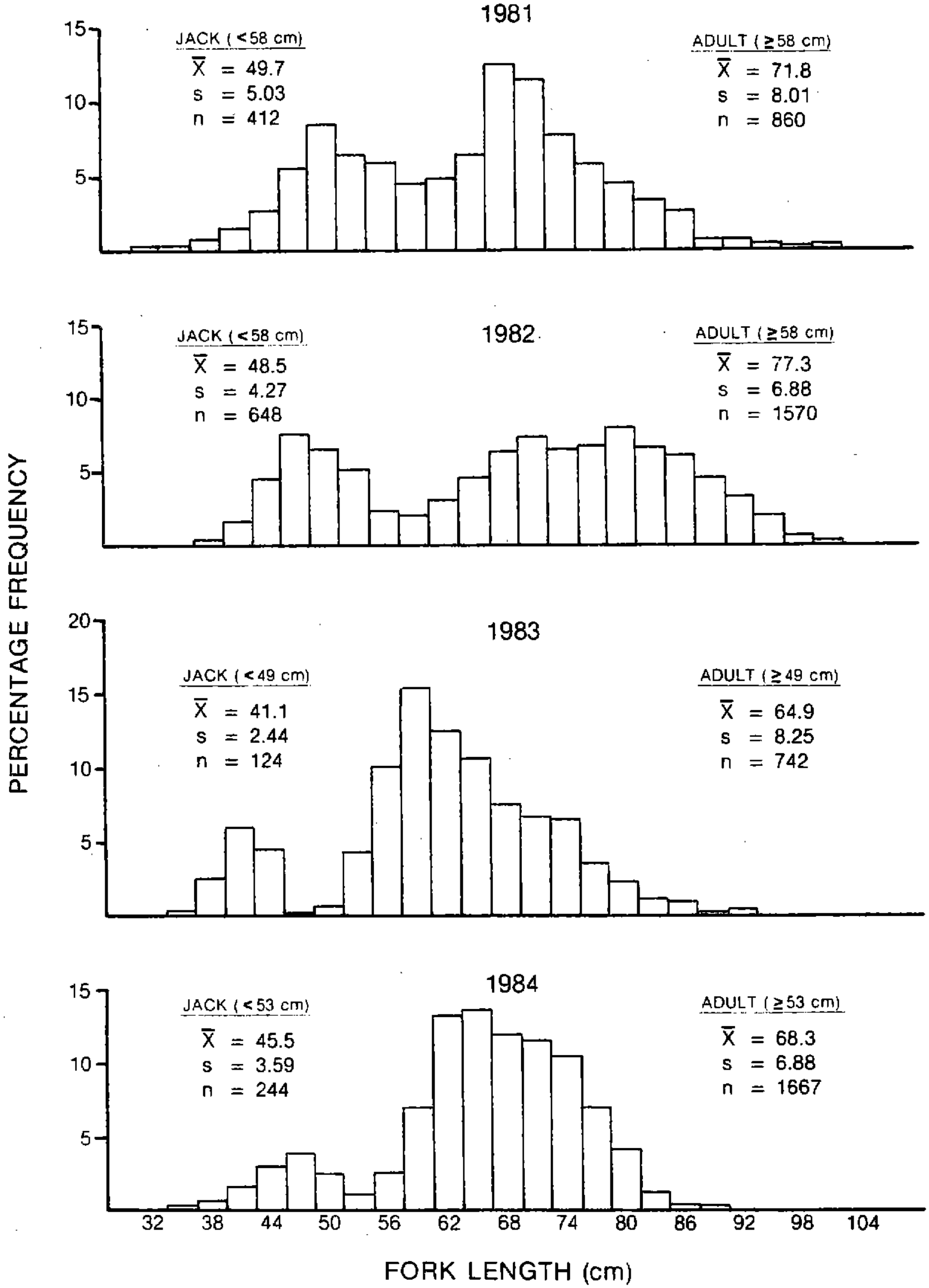


FIGURE 3. Length-frequency distributions of chinook salmon captured during beach seining operations in the Klamath River estuary during 1981-1984 (3 cm groupings with midpoints noted).

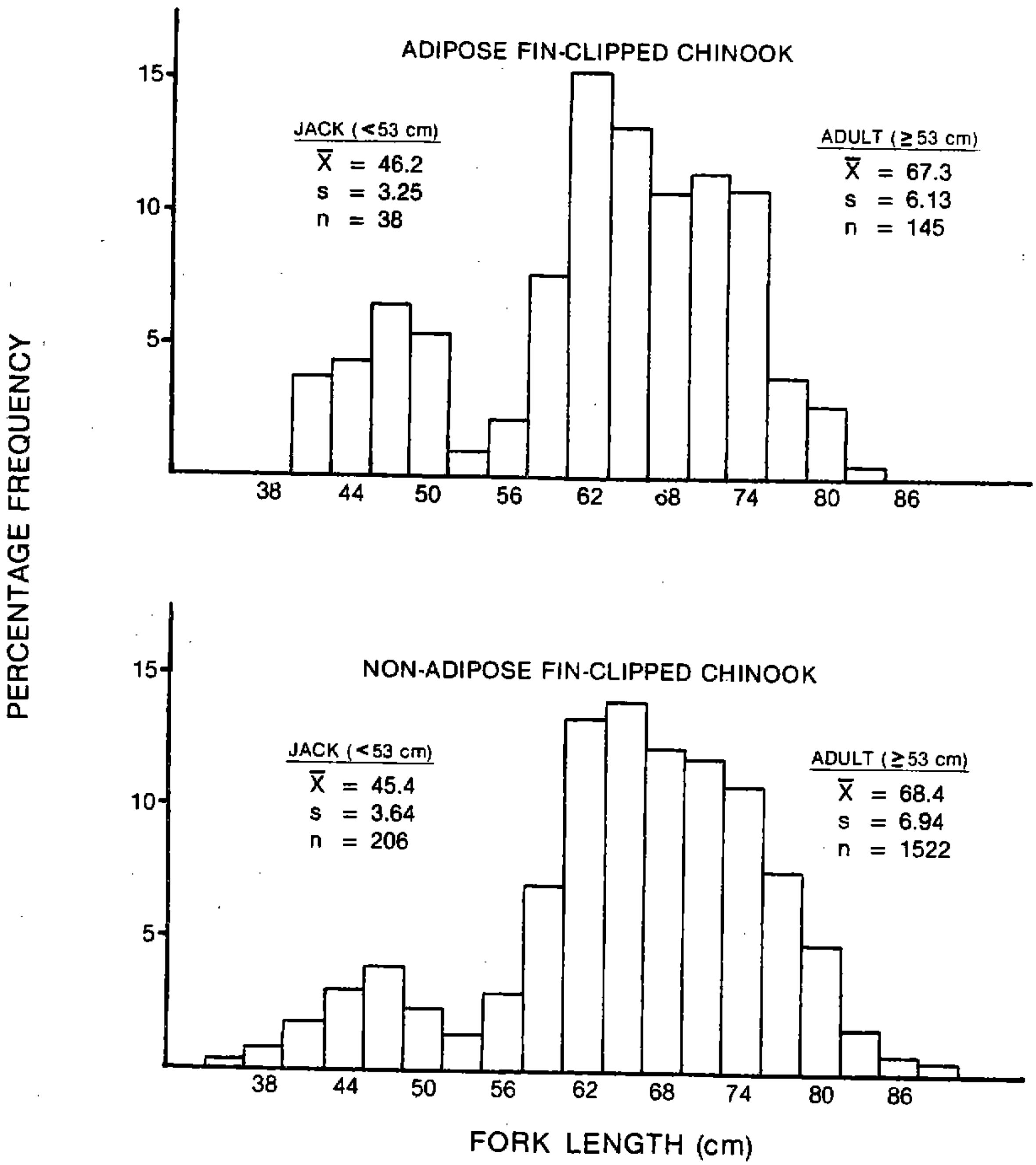


FIGURE 4. Length-frequency distributions of adipose and non-adipose fin-clipped chinook salmon captured during 1984 beach seining operations in the Klamath River estuary (3 cm groupings with midpoints noted).

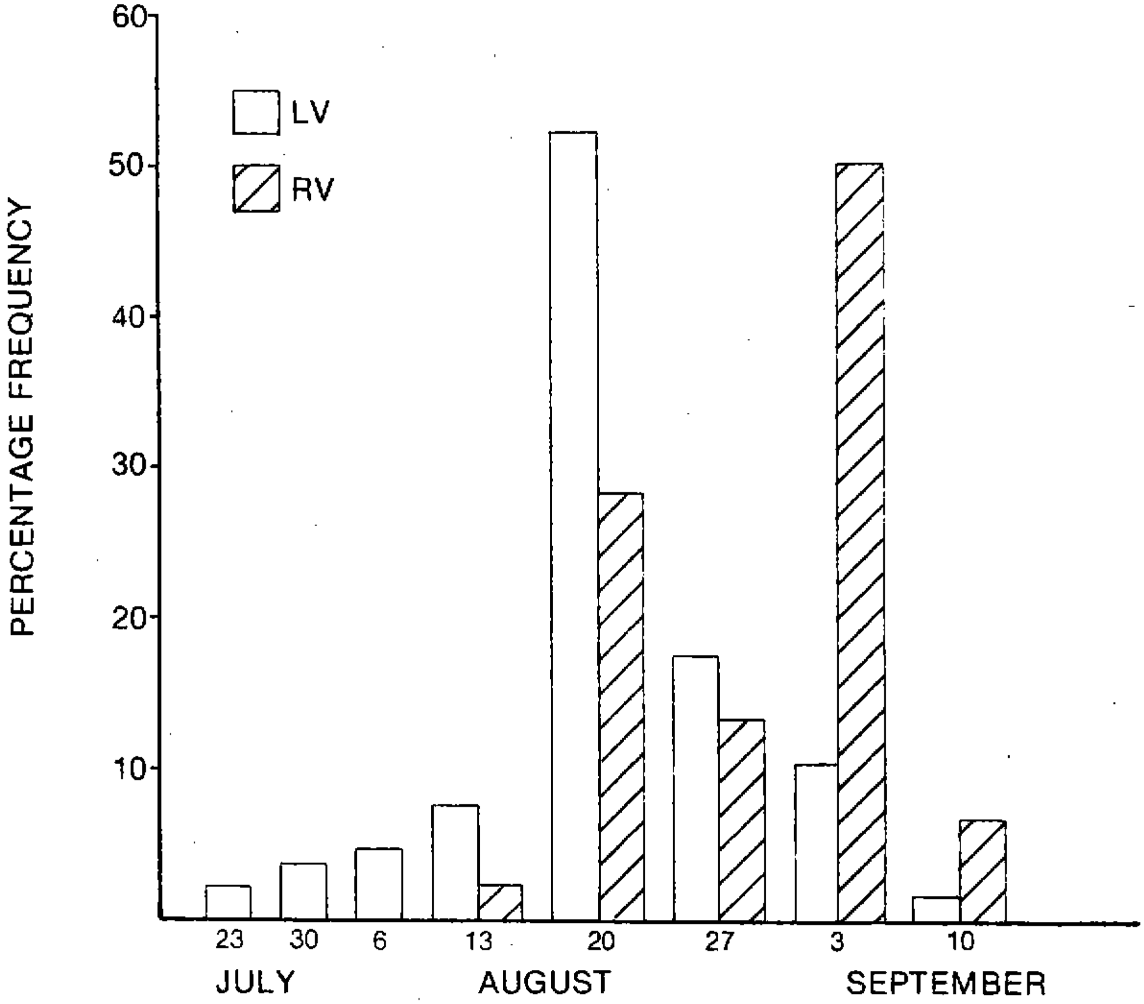


FIGURE 5. Percentage occurrence of LV- and RV-clipped chinook salmon by week during 1984 beach seining operations in the Klamath River estuary.

TRH fall chinook appear to have entered the river later than IGH fall chinook.

Differences in run timing between fall chinook age classes were observed in 1984. Beach seine data from an aged scale sample of 890 fall chinook taken during the run peak period was stratified into three equal time periods and significant differences in run timing by age were noted from the data in Table 2 (chi-square analysis, $p < 0.05$):

TABLE 2. Age class contribution during three equal time intervals in the 1984 Klamath River beach seine sample, determined through scale analysis.

Age	RUN TIMING			Total
	7/27 - 8/09	8/10 - 8/23	8/24 - 9/07	
2	9 (8.2%)	24 (21.8%)	77 (70.0%)	110 (100%)
3	39 (10.8%)	124 (34.5%)	197 (54.7%)	360 (100%)
4	90 (21.4%)	168 (40.0%)	162 (38.6%)	420 (100%)

The difference between 2- and 4-year old run timing was most pronounced, with 3-year-olds exhibiting an intermediate timing. Jacks entered the sample later in the run, with 70% in the last third of the run peak period, while 4-year-olds occurred in greater proportion (61.4%) in the first two-thirds of the period. The late timing of 2-year-olds coincides with the previously noted late entry pattern of TRH fall chinook. Chinook of Trinity River origin appear, on the average, to exhibit a more accelerated maturity schedule than those originating from other stocks in the Klamath River basin.

Gill-Net Marking and Hook Scarring Investigations

Gill-Net Markings

Markings directly attributed to previous contact with gill nets were observed on none of the jacks and on 14 adult chinook salmon examined during 1984 beach seining activities in the Klamath River estuary. The observed marking frequency (0.67%) increased from the 0.0% observed in the 1983 beach seining program. The fact that gill-net harvest of chinook in the estuary increased 14.4 times from 812 in 1983 to 11,673 in 1984 seems to indicate a general relationship between rate of harvest in this area and the observed marking rate.

To provide a means of comparison, chinook were examined for gill-net marks at IGH, Shasta River weir, and TRH in October after beach seining operations were completed. Gill-net marks were not observed on any of the fish examined at IGH. At the Shasta River weir, gill-net marks were observed on 1 of 27 adults (3.7%) and on none of the jacks examined. At TRH, gill-net marks were seen on 10 of 91 adults (11.0%) and on none of the jacks examined. The total combined marking rate observed on adults at the upriver sites (6.1%) was considerably higher than that observed in the beach seine, which would be expected since most in-river net harvest occurs between these sample areas. Similar results were noted in previous sampling seasons (USFWS 1982, 1983, 1984).

Reservations concerning the collection and potential use of gill net marking data on Klamath River chinook were stated in previous annual reports. Meaningful gill net marking data can be collected under carefully controlled conditions; however, the utility of such information beyond provision of a very general index of net harvest rate in the basin may be questioned.

Hook Scars

Scars or wounds directly attributable to hooks were observed on 23 of 246 jack (9.3%) and 451 of 1,855 adult (24.3%) chinook salmon examined during 1984 beach seining activities in the Klamath River estuary for an overall frequency of 22.6% (Table 3). Healed hook scars were more common than fresh (13.4% versus 10.4%) and moderate-major scars were more common than minor (16.6% versus 7.3%). Two or more scars attributed to separate hooking incidents were observed on 2.8% of all chinook examined. Hooks were found imbedded in 2 of 2,101 (0.1%) chinook examined. One of 2,101 chinook (0.05%) had been blinded in one eye from a hooking incident. The incidence of hook scarred fish in the 1984 beach seine sample remained relatively constant throughout the season.

Within the 1984 total sample of 536 scars, 49.4% were found on the upper jaw and 22.8% were found on the lower jaw, which compares closely with frequencies observed in the 1981, 1982 and 1983 samples. Within the 1983 sample of 378 scars, 49.2% occurred on the upper jaw and 22.2% occurred on the lower jaw, while the 1982 sample of 1,510 scars consisted of 48.8% and 24.2% on upper and lower jaw structures, respectively. Within the 1981 sample of 503 scars, comparable frequencies were 49.6% and 24.2% on the upper and lower jaws, respectively. Table 4 represents recorded occurrence frequencies for respective categories within the total 1984 sample of 536 scars. These frequencies do not directly convert to occurrence frequencies of scarring within the total sample of 2,101 chinook as 60 multiple hook scarred fish are represented by 123 individual scars.

A significant difference was found in mean lengths between hook-scarred (46.7 cm) and non-scarred (45.4 cm) jack chinook (t-test; $p < 0.05$, Figure 6). Size dependent, differential rates of shaker mortality in the 1984 ocean troll fishery may have resulted in an elevated mean length for that group of jacks surviving a hooking incident, by cropping the smaller, weaker fish. Similar results were noted for jack fall chinook captured during previous sampling seasons. Mean lengths of hook-scarred adults (68.5 cm) were not significantly different (t-test; $p > 0.05$) from non-scarred adults (68.2 cm).

Seasonal hook-scarring incidences for adult and jack chinook decreased for the second consecutive year in 1984 (Figure 7). This decline appears to

TABLE 3. Percentage occurrence of hook scars observed on 2,101 Klamath River chinook salmon sampled during 1984 beach seining operations.

Type of Scar	RUN COMPONENT Jack	Adult	All Chinook
Fresh Hook Scar	4.9	11.2	10.4
Healed Hook Scar	4.9	14.5	13.4
Minor Hook Scar	2.8	7.9	7.3
Moderate-Major Hook Scars	7.7	17.7	16.6
Single Hook Scar 1/	9.3	24.3	22.6
Two Hook Scars 2/	1.2	3.0	2.8
Three Hook Scars	0.0	0.2	0.1
Hook Imbedded	0.0	0.1	0.1
Blind In One Eye	0.0	0.05	0.05

1/ All fish exhibiting one or more hook scars included in this category.

2/ All fish exhibiting two or more hook scars caused by separate hooking incidents included in this category.

TABLE 4. Categorical frequencies of hook scars within a total sample of 536 scars observed during 1984 beach seining operations.

Location	Stage	SEVERITY Minor	Moderate	Major	Total
Upper Jaw	Fresh	8.6	9.1	4.9	22.6
	Healed	5.6	13.4	7.8	26.8
	Total	14.2	22.5	17.7	49.4
Lower Jaw	Fresh	3.7	5.8	2.4	11.9
	Healed	3.9	3.2	3.7	10.8
	Total	7.6	9.0	6.1	22.7
Eye and Proximity	Fresh	0.4	0.0	1.3	1.7
	Healed	0.0	2.1	1.7	3.7
	Total	0.4	2.1	3.0	5.4
Opercle	Fresh	0.0	0.4	0.6	0.9
	Healed	0.4	0.9	1.5	2.8
	Total	0.4	1.3	2.1	3.7
Isthmus and Proximity	Fresh	1.9	2.1	0.6	4.6
	Healed	3.0	2.6	1.3	6.9
	Total	4.9	4.7	1.9	11.5
Other Head Areas	Fresh	1.9	0.9	1.1	3.9
	Healed	0.6	1.1	1.7	3.4
	Total	2.5	2.0	2.8	7.3
All Head Areas Combined	Fresh	16.4	18.3	10.9	45.6
	Healed	13.4	23.3	17.7	54.4
	Total	29.8	41.6	28.6	100.0

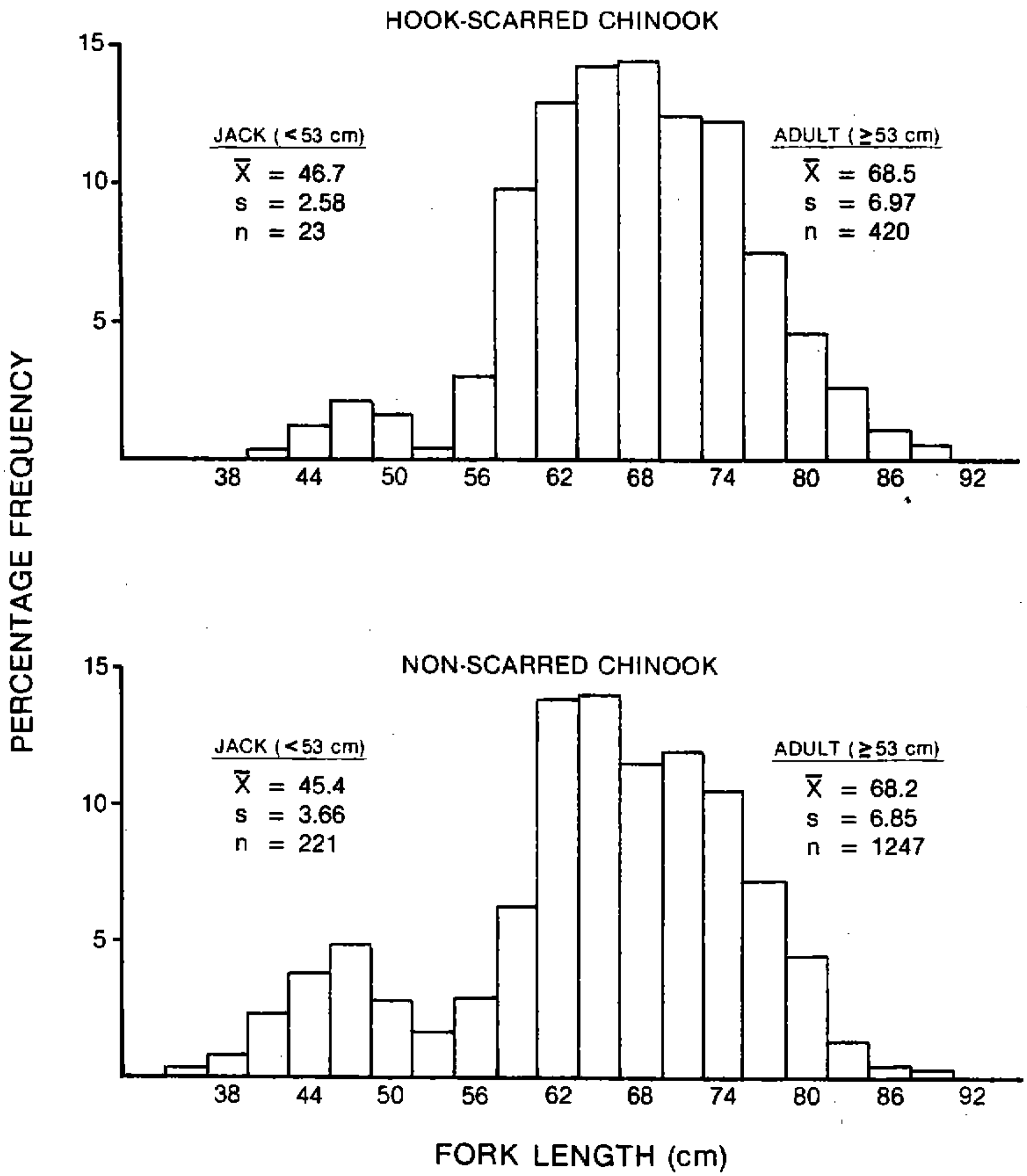


FIGURE 6. Length-frequency distributions of hook-scarred and non-scarred chinook salmon captured during 1984 beach seining operations in the Klamath River estuary (3 cm groupings with midpoints noted).

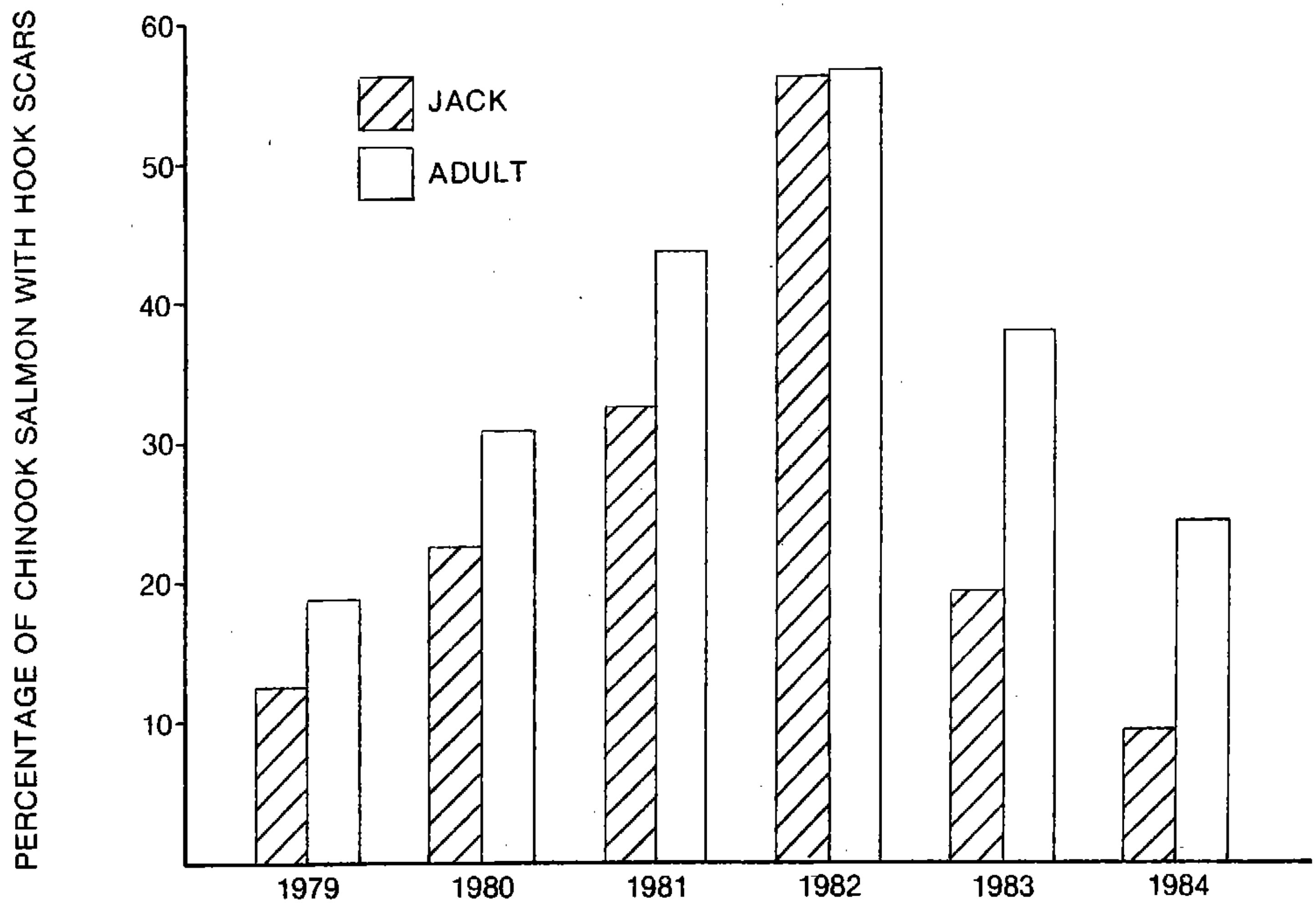


FIGURE 7. Jack and adult chinook salmon hook scarring rates observed during 1979-1984 beach seining operations in the Klamath River estuary.

be a reflection of harvest trends in the commercial troll fishery during 1983-1984 (Figure 8). Since 1981, methods used to observe and record hook scarring incidence have been standardized in the beach seine program. Examining data from 1981-1984, it can be seen that hook-scarring rates increased sharply from 1981 to 1982, as did ocean landings during those years. Similarly, declining hook-scarring rates between 1982 and 1984 may reflect decreases in ocean landings during 1983-1984.

Mark-Recapture Analysis

Totals of 1,016, 2,363, 1,018, 588 and 1,007 fall chinook salmon were tagged and released during beach seining operations in the Klamath River estuary in 1979, 1980, 1982, 1983 and 1984 respectively. A total of 877 tags were recovered during the five seasons, for an overall recovery rate of 0.146 (Table 5). The recovery rate in 1984, 0.138, was up from that of 1983, and comparable to rates observed in 1979, 1980, and 1982 (0.155, 0.141, and 0.175 respectively). Recovery rates of fish tagged and released during USFWS beach seining operations appear to be largely influenced by harvest levels in the Hoopa Valley Reservation (HVR) Indian gill net fishery, as this has usually been the primary source of recovery information in the basin. The lowest tag recovery rate, 0.117, observed in 1983, occurred during a year when net harvest was at its lowest level during the 1979-1984 sample period.

In 1984, 121 of 137 tags recovered were accompanied with sufficient information to be used in migration time and rate calculations. Recovery areas in the Klamath-Trinity basin for fall chinook tagged during 1979-1984 are presented in Figure 9. Table 6 illustrates general migration patterns of fall chinook in the basin in 1984. Migration rates observed in 1984 were generally similar to those observed during 1979-1982 in the Klamath basin. A general analysis of upstream migration behavior of fall chinook within the Klamath River system during 1979-1982 was presented in the 1982 Annual Report (USFWS 1983). During 1983, data from tagging studies exhibited patterns quite different from those observed during the 1979-1982 or 1984 study periods, with fall chinook upstream migration rates being much faster during 1983. Fall chinook salmon run timing to the mouth of the river was later in 1983 than in any of the other periods studied. Run timing appears to be strongly correlated with in-river migration rate, with faster rates occurring during years when later run timings occur. For example, faster migration rates to IGH occurred in years when the peak adult chinook beach seine catch (an indicator of run timing to the river mouth) was later than normal (Figure 10). This between-season trend is in agreement with data collected during the 1979-1982 study period which showed that, within a season, fall chinook entering the river later in the run proceeded upriver at a greater rate than those entering earlier (USFWS 1983).

Catch/Effort and Run Timing Analysis

Numbers of fall chinook captured per seine haul in 1984 were 1.20 for jacks and 11.31 for adults. Comparative jacks and adult catch/effort (C/E) values were 0.47 and 2.82 in 1983, 3.04 and 8.24 in 1982, 1.90 and 3.92 in 1981 and 2.40 and 1.57 in 1980 respectively. For reasons discussed herein, direct comparison of these figures would not be valid in addressing differences in magnitude between 1980, 1981, 1982, 1983, and 1984 fall chinook runs. Comparisons of total adult chinook C/E data depicting general beach

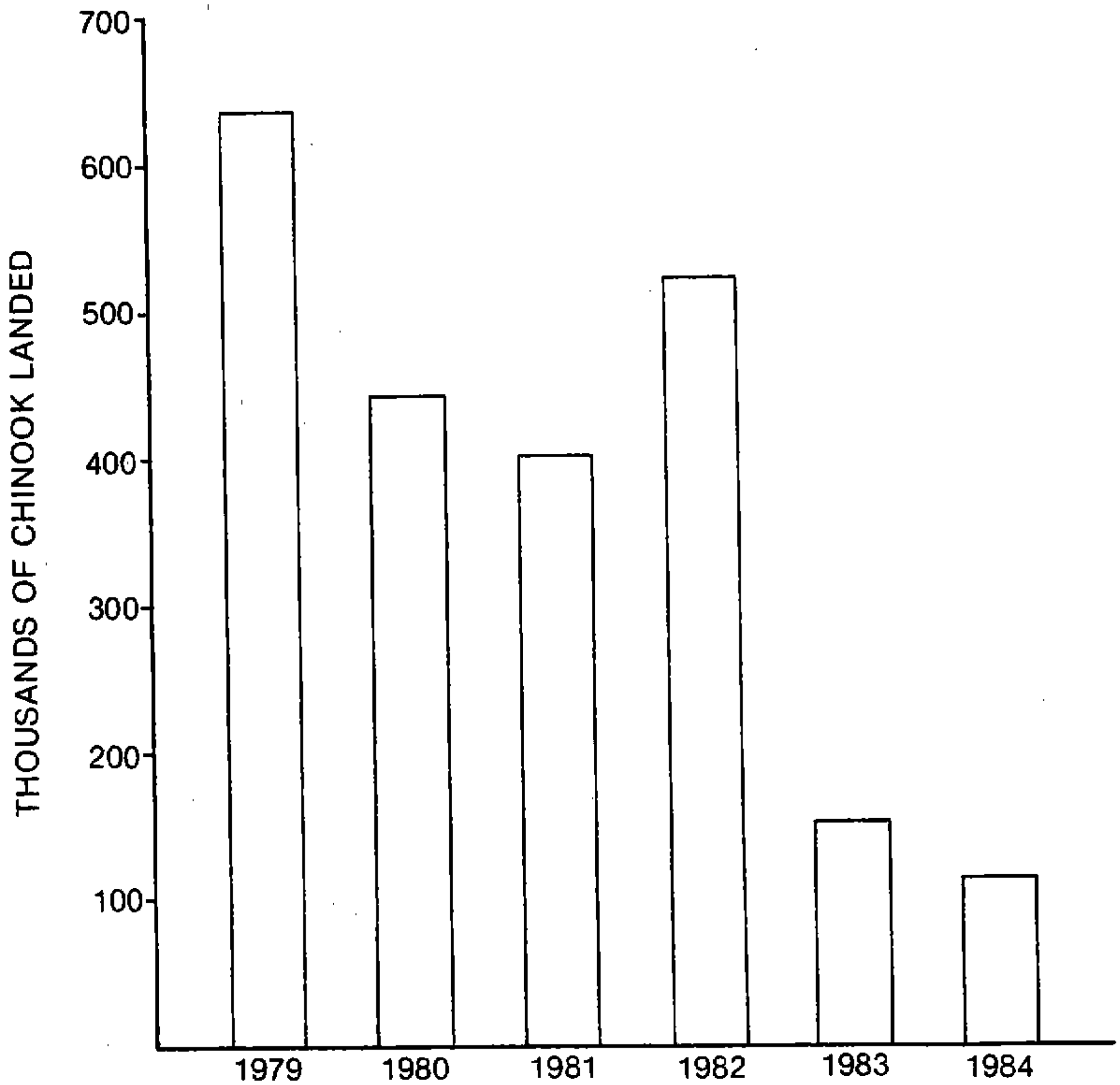
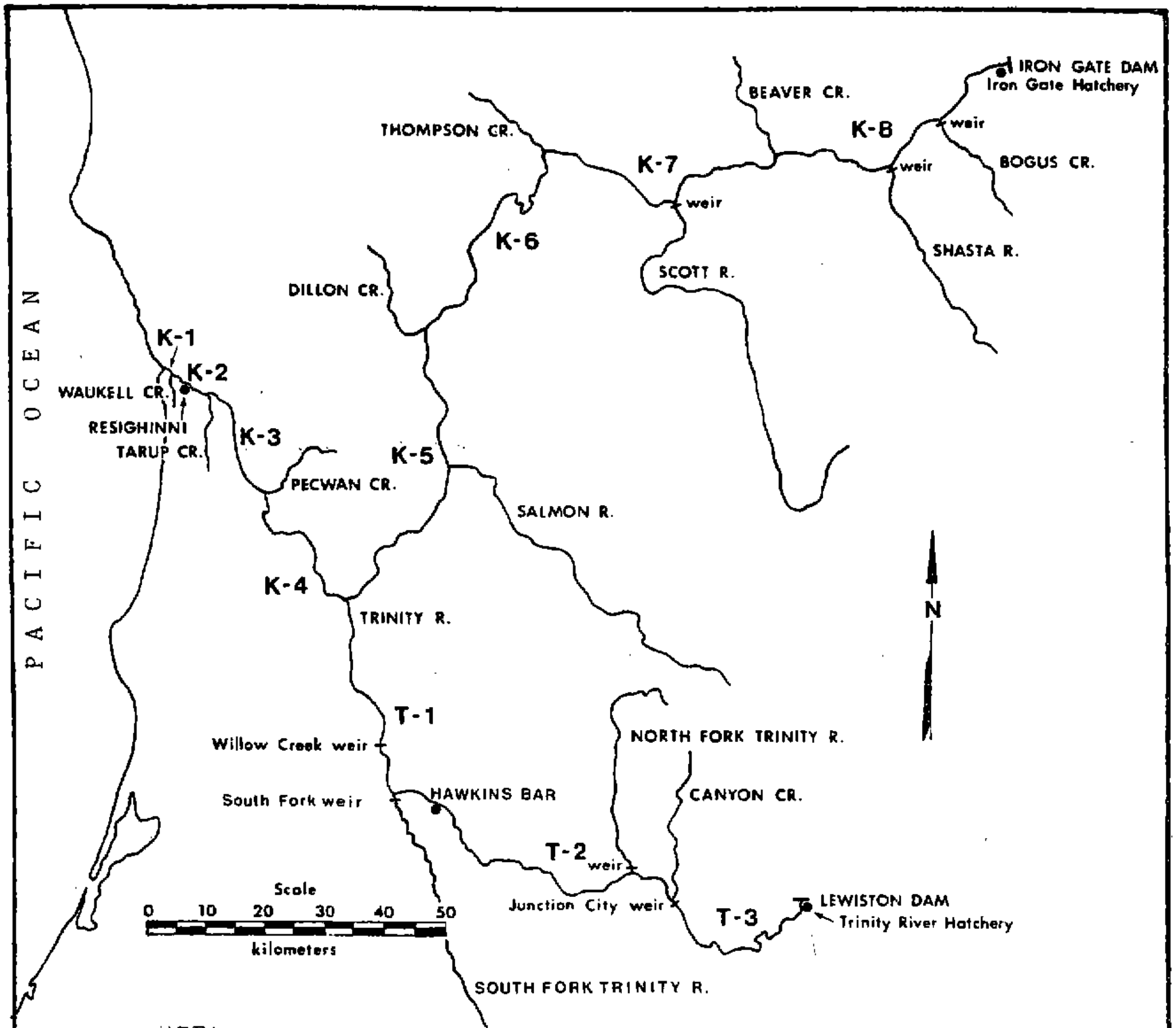


FIGURE 8. Ocean commercial troll landings from Coos Bay, Oregon, to Fort Bragg, California, during 1979-1984.

TABLE 5. Recovery data from 5,992 chinook salmon tagged by the U.S. Fish and Wildlife Service on the Klamath River during 1979-1984.

Source	NUMBER RECOVERED					Total
	1979	1980	1982	1983	1984	
Gill Net Fishery	14	111	46	14	31	216
USFWS Beach Seine	22	67	14	7	20	130
Shasta River Weir	50	21	19	0	3	93
In-River Sport Fishery	14	43	13	11	7	88
Trinity River Hatchery	18	32	16	14	20	100
Iron Gate Hatchery	23	14	20	12	14	83
Spawning Ground Surveys	7	25	1	0	4	37
Bogus Creek Weir	-	-	22	1	8	31
Willow Creek Weir	5	6	8	4	11	34
CDFG Beach Seine	4	11	3	-	12	30
Scott River Weir	-	-	8	2	2	12
Junction City Weir	0	2	0	-	4	6
South Fork Trinity Weir	-	-	-	-	1	1
North Fork Trinity Weir	-	-	1	0	0	1
Ocean	0	1	0	0	1	2
Other (Found Dead)	0	0	8	4	1	13
Totals	157	333	179	69	139	877



AREA	
K-1	Mouth of Klamath River to Waukell Creek (km 5)
K-2	Waukell Creek to Tarup Creek (km 13)
K-3	Tarup Creek to Pecwan Creek (km 41)
K-4	Pecwan Creek to Trinity River (km 70)
K-5	Trinity River to Dillon Creek (km 136)
K-6	Dillon Creek to Thompson Creek (km 198)
K-7	Thompson Creek to Beaver Creek (km 259)
K-8	Beaver Creek to Iron Gate Dam (km 306)
T-1	Trinity River mouth to Hawkins Bar (km 134)
T-2	Hawkins Bar to Canyon Creek (km 197)
T-3	Canyon Creek to Lewiston Dam (km 249)

FIGURE 9. Overview map of the Klamath-Trinity basin delineating recovery areas for chinook tagged during 1979-1984 mark-recapture studies.

TABLE 6. Migration data from 121 recoveries of tagged fall chinook salmon within the Klamath-Trinity basin during 1984.

Area	Kilometers From River Mouth	Tag Recoveries	MIGRATION TIME (Days)		MIGRATION RATE (Km/Day)	
			Range	Mean	Range	Mean
K-1	0 - 5	46	1-27 1/	7.1 1/	NA	NA
K-2	5 - 13	15	1-27	10.1	0.2- 5.0	1.1
K-3	13 - 41	0	-	-	-	-
K-4	41 - 70	4	6-13	8.3	3.5- 7.5	6.2
K-5	70 - 136	1	NA	30	NA	2.6
K-6	136 - 198	0	-	-	-	-
K-7	198 - 259	2	42-46	44	5.0- 5.4	5.2
K-8	259 - 306	16	31-59 2/	43.4 2/	5.1- 9.7 2/	7.1 2/
IGH	306	14	45-68	53.6	4.5- 6.8	5.8
T-1	70 - 134	14	10-51	23.2	2.4-10.7	4.8
T-2	134 - 197	0	-	-	-	-
T-3	197 - 249	5	22-48	36	4.1- 9.0	6.2
TRH	249	20	47-87	61.2	2.9- 5.3	4.2

1/ Does not include chinook that were recaptured on the same day they were tagged.

2/ Does not include chinook found dead on spawning grounds.

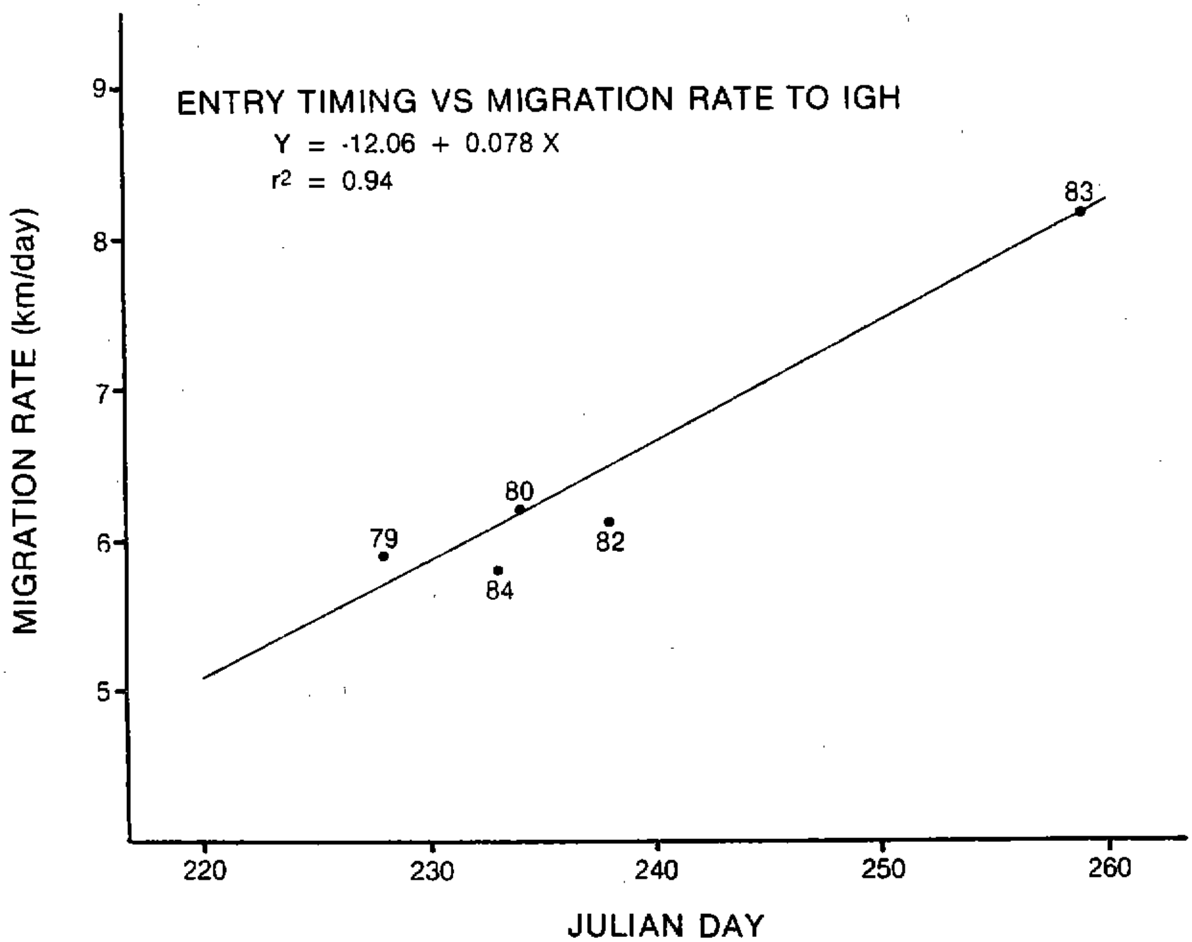


FIGURE 10. Linear relationship between peak day adult chinook beach seine catch (entry timing index) and in-river migration rate to Iron Gate Hatchery during 1979-1984 (1981 migration data unavailable).

seine sample magnitude and run timing trends during 1980-1984 are given in Figures 11 and 12.

Treatments to the database similar to those described in previous years (USFWS 1982a and 1983) were necessary in order to compare C/E data between years. Changes in physical and environmental conditions in the estuary, differences in run timing between age classes, gear selectivity, migration patterns of fish through the estuary, holding of fish in the estuary and inconsistent sampling effort all provide potential sources of bias in comparisons between these data.

Variations in physical and environmental conditions in the estuary may have exerted more influence on C/E values in 1984, relative to previous years, as the seining site location changed markedly from sites in 1979-1983. Figure 13 illustrates the differences in site orientation during 1981-1984. From 1979-1983, the beach seine site faced up-river into the open estuary. In 1984, for the first time since seining began in 1979, the seining site was located at a point where the river was narrowly constricted. This restriction could have rendered entering salmon more accessible to seining activities. As a result, a higher percentage of the run was apparently sampled in 1984. This conclusion is substantiated by information on tagged-untagged ratios of adult fall chinook tagged in the beach seine program and captured in the Klamath River Indian gill net fishery during 1982-1984. The tagged-untagged ratio in 1984 was 1:95.2 (0.0105) as compared to tagged-untagged ratios of 1:184.9 (0.0054) and 1:123.1 (0.0081) in 1983 and 1982 respectively. Although the 1984 in-river run size was the smallest on record in the Klamath, the site location, as discussed above, may have resulted in the highest C/E values yet obtained in the beach seine program. Unfortunately, such site influence cannot entirely be controlled or otherwise treated in the data, and may therefore present a major source of bias in C/E data comparisons between seasons.

Recaptures were eliminated from the data to treat any tendency of chinook to linger in the lower estuary. Recapture rates, 1.5% in 1984 and averaging 1.8% from 1979 to 1984, indicate that this bias is minor.

Catch/effort statistics during 1980-1984 indicate that most movement of chinook into the estuary occurs over a 1- to 2-hour period between the latter stage of outgoing and the beginning of incoming tide and tends to become more concentrated later in the day (Table 7). No bias related treatment appears necessary in this case as beach seining efforts from 1980 to 1984 have remained fairly proportional with regard to targeting time of day and tidal stage (Tables 8 and 9).

To compensate for bias in comparison of total season C/E between a high effort year and a low effort year (e.g. 1980, 8.3 sets/day and 1984, 6.0 sets/day) seasonal C/E data were compared from the three highest consecutive daily seine hauls (peak three sets) only. This treatment appears effective considering that 73%, 80%, 80%, 77% and 80% of the total chinook catches during 1980, 1981, 1982, 1983 and 1984 respectively were captured in the peak three daily sets. Figure 14 illustrates the difference between (cumulative) C/E values of adult chinook for all sets and peak three sets for representative high (1980) and low (1984) effort years. In 1980 the final

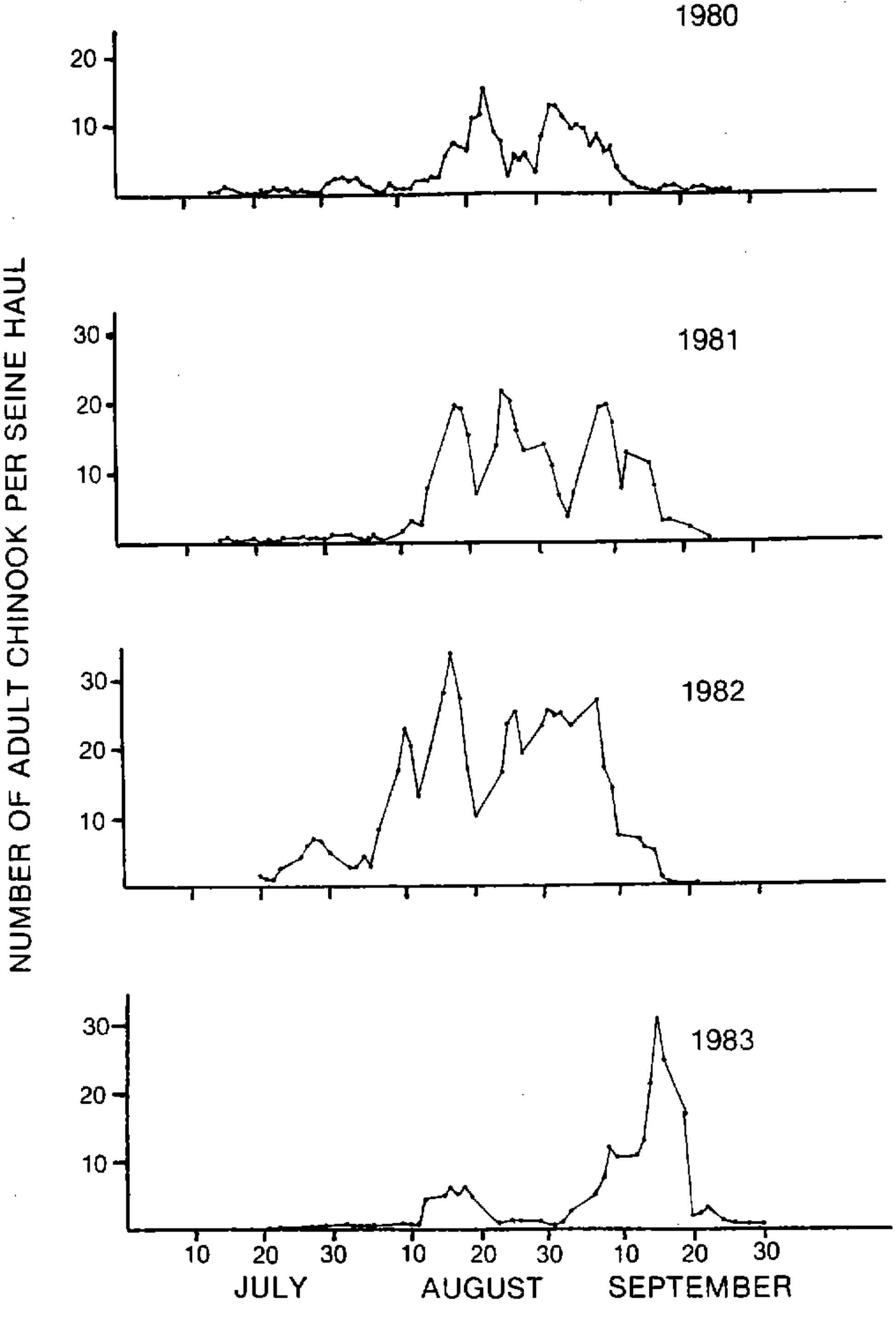


FIGURE 11. Three-day moving averages of the numbers of adult chinook salmon captured per beach seine haul (peak three sets) in the Klamath River estuary during 1980-1983.

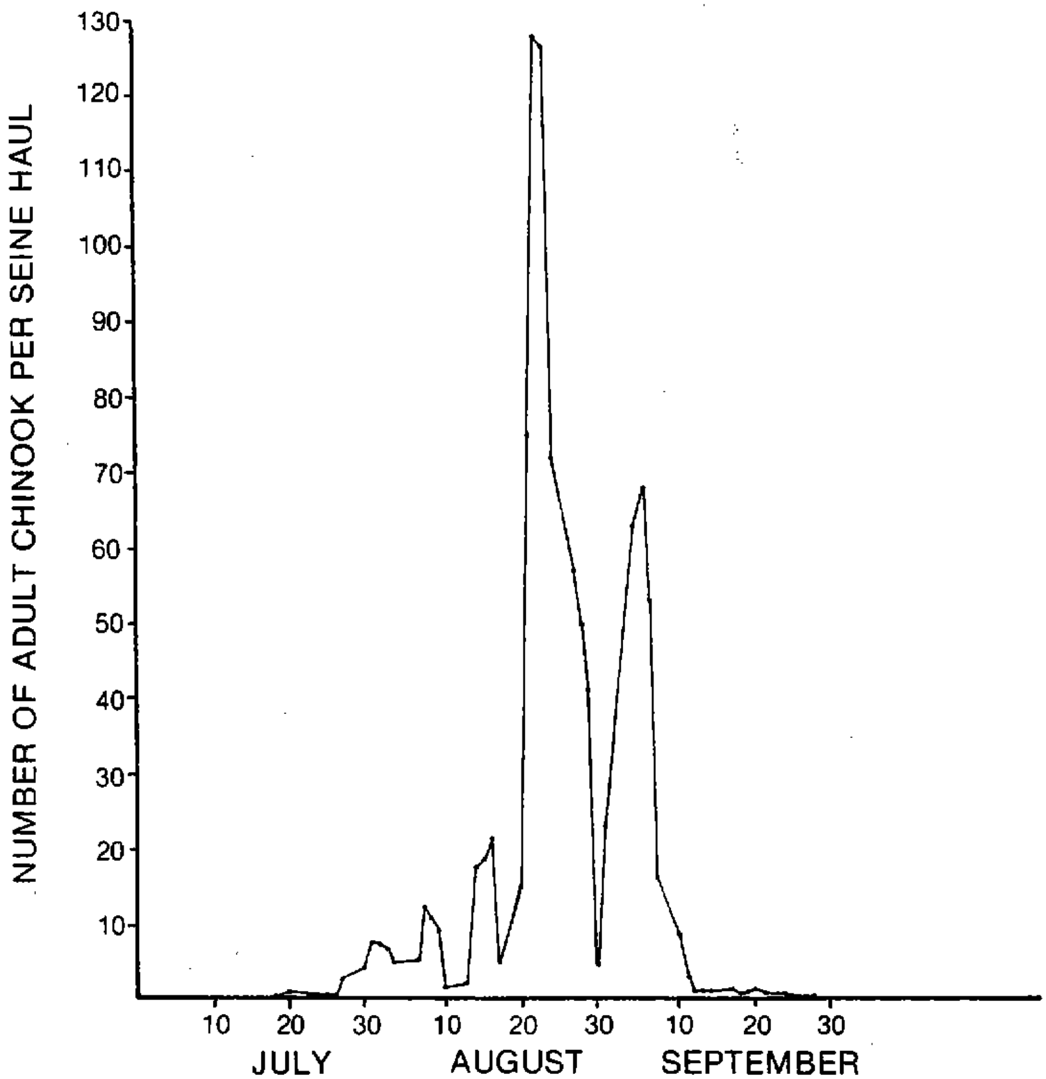


FIGURE 12. Three-day moving average of numbers of adult chinook salmon captured per beach seine haul (peak three sets) in the Klamath River estuary in 1984.

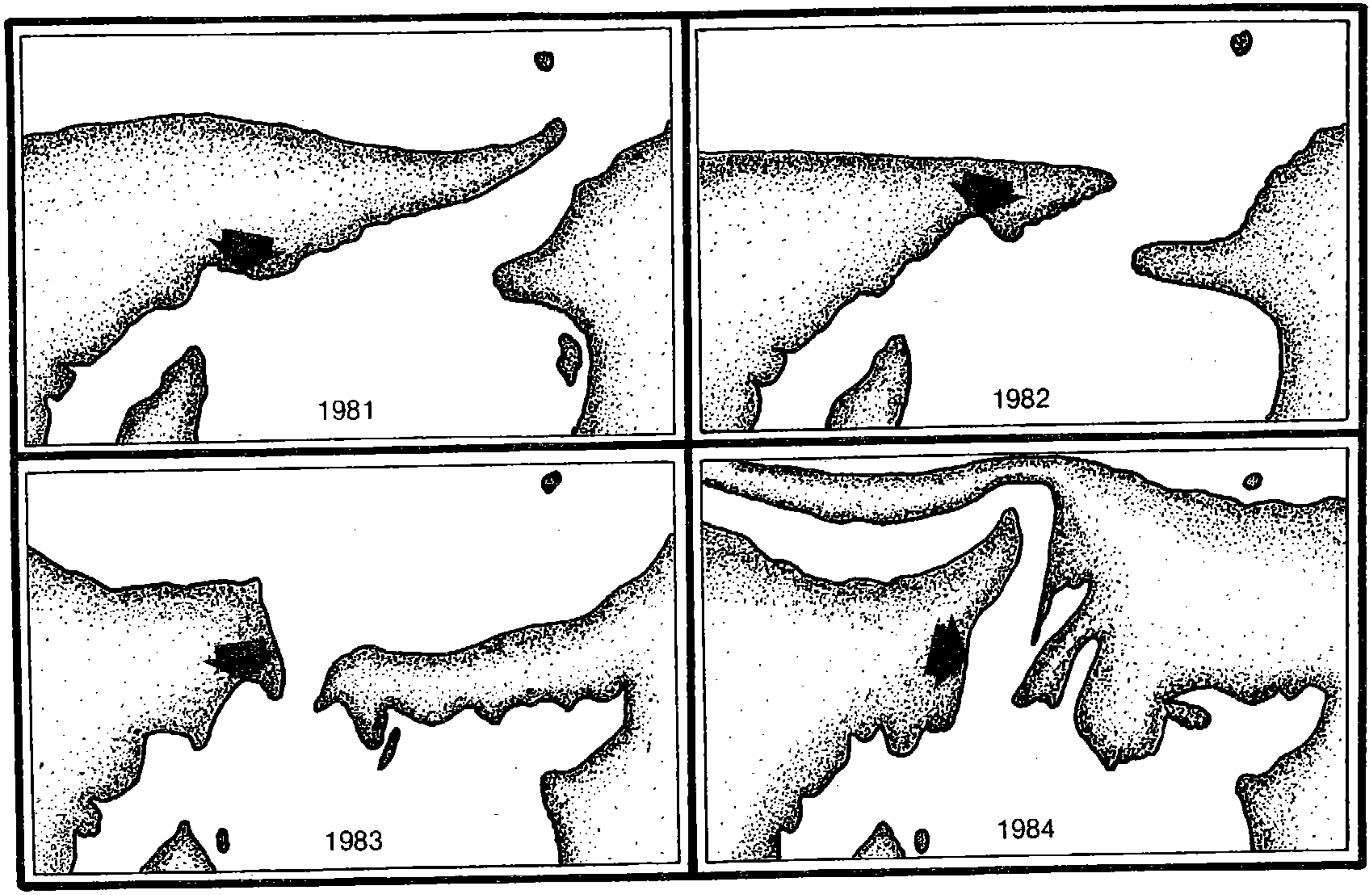


FIGURE 13. USFWS beach seine site orientations in the Klamath River estuary during 1981-1984.

TABLE 7. Adult chinook salmon catch per seine haul by time of day and tidal stage during 1980-1984 beach seining operations in the Klamath River estuary (all sets included).

Year	Tidal Stage	HOURS OF DAY 0800-1100	1100-1400	1400-1700	All Hours
1984	Outgoing	0.83	10.44	15.04	10.60
	Low Slack	0.00	11.92	46.67	21.15
	Incoming	2.25	8.83	15.77	11.10
	High Slack	0.00	7.13	1.00	5.45
	ALL TIDES	1.12	9.65	16.67	11.31
1983	Outgoing	8.08	3.92	3.56	4.16
	Low Slack	0.00	7.44	0.33	5.67
	Incoming	1.50	1.23	2.60	1.67
	High Slack	0.00	0.50	0.67	0.50
	ALL TIDES	4.60	2.47	2.96	2.82
1982	Outgoing	24.87	6.27	14.46	11.70
	Low Slack	11.66	10.88	17.50	12.00
	Incoming	5.08	6.54	4.60	5.86
	High Slack	0.00	1.10	0.00	0.93
	ALL TIDES	12.29	6.24	10.44	8.24
1981	Outgoing	1.00	4.54	5.38	4.29
	Low Slack	0.50	1.90	11.00	3.91
	Incoming	0.55	5.26	3.41	3.85
	High Slack	0.00	2.94	7.40	3.35
	ALL TIDES	0.58	4.25	5.29	3.92
1980	Outgoing	0.67	0.75	1.27	0.90
	Low Slack	0.22	1.24	2.79	1.15
	Incoming	1.19	1.42	4.32	2.27
	High Slack	0.00	1.09	1.00	0.92
	ALL TIDES	0.81	1.21	3.01	1.65

TABLE 8. Effort (number of sets) by time of day and tidal stage during 1980-1984 beach seining operations in the Klamath River estuary.

		HOURS OF DAY			
Year	Tidal Stage	0800-1100	1100-1400	1400-1700	All Hours
1984	Outgoing	23	70	53	146
	Low Slack	2	12	6	20
	Incoming	8	76	52	136
	High Slack	0	8	3	11
	ALL TIDES	33	166	114	313
1983	Outgoing	12	59	54	125
	Low Slack	0	9	3	12
	Incoming	12	99	48	159
	High Slack	1	4	3	8
	ALL TIDES	25	171	108	304
1982	Outgoing	8	44	50	102
	Low Slack	3	9	2	14
	Incoming	12	79	35	126
	High Slack	1	13	1	15
	ALL TIDES	24	145	88	257
1981	Outgoing	10	39	21	70
	Low Slack	12	29	14	55
	Incoming	27	78	49	154
	High Slack	4	17	5	26
	ALL TIDES	53	163	89	305
1980	Outgoing	54	59	60	173
	Low Slack	36	21	19	76
	Incoming	89	140	105	334
	High Slack	7	32	15	54
	ALL TIDES	186	252	199	637

TABLE 9. Percent effort (from number of sets) by time of day and tidal stage during 1980-1984 beach seining operations in the Klamath River estuary.

		HOURS OF DAY			
Year	Tidal Stage	0800-1100	1100-1400	1400-1700	All Hours
1984	Outgoing	7.4	22.4	16.9	46.7
	Low Slack	0.6	3.8	1.9	6.3
	Incoming	2.6	24.3	16.6	43.5
	High Slack	0.0	2.6	0.9	3.5
	ALL TIDES	10.6	53.1	36.3	100.0
1983	Outgoing	4.0	19.4	17.8	41.1
	Low Slack	0.0	3.0	1.0	4.0
	Incoming	4.0	32.6	15.8	52.3
	High Slack	0.3	1.3	1.0	2.6
	ALL TIDES	8.2	56.3	35.5	100.0
1982	Outgoing	3.1	17.1	19.5	39.7
	Low Slack	1.2	3.5	0.8	5.5
	Incoming	4.7	30.7	13.6	49.0
	High Slack	0.4	5.0	0.4	5.8
	ALL TIDES	9.4	56.4	34.2	100.0
1981	Outgoing	3.3	12.8	6.9	23.0
	Low Slack	3.9	9.5	4.6	18.0
	Incoming	8.8	25.6	16.0	50.5
	High Slack	1.3	5.6	1.6	8.5
	ALL TIDES	17.3	53.5	29.2	100.0
1980	Outgoing	8.5	9.2	9.4	27.1
	Low Slack	5.6	3.3	3.0	12.0
	Incoming	13.9	21.9	15.5	52.4
	High Slack	1.1	5.0	2.3	8.5
	ALL TIDES	29.2	39.6	31.2	100.0

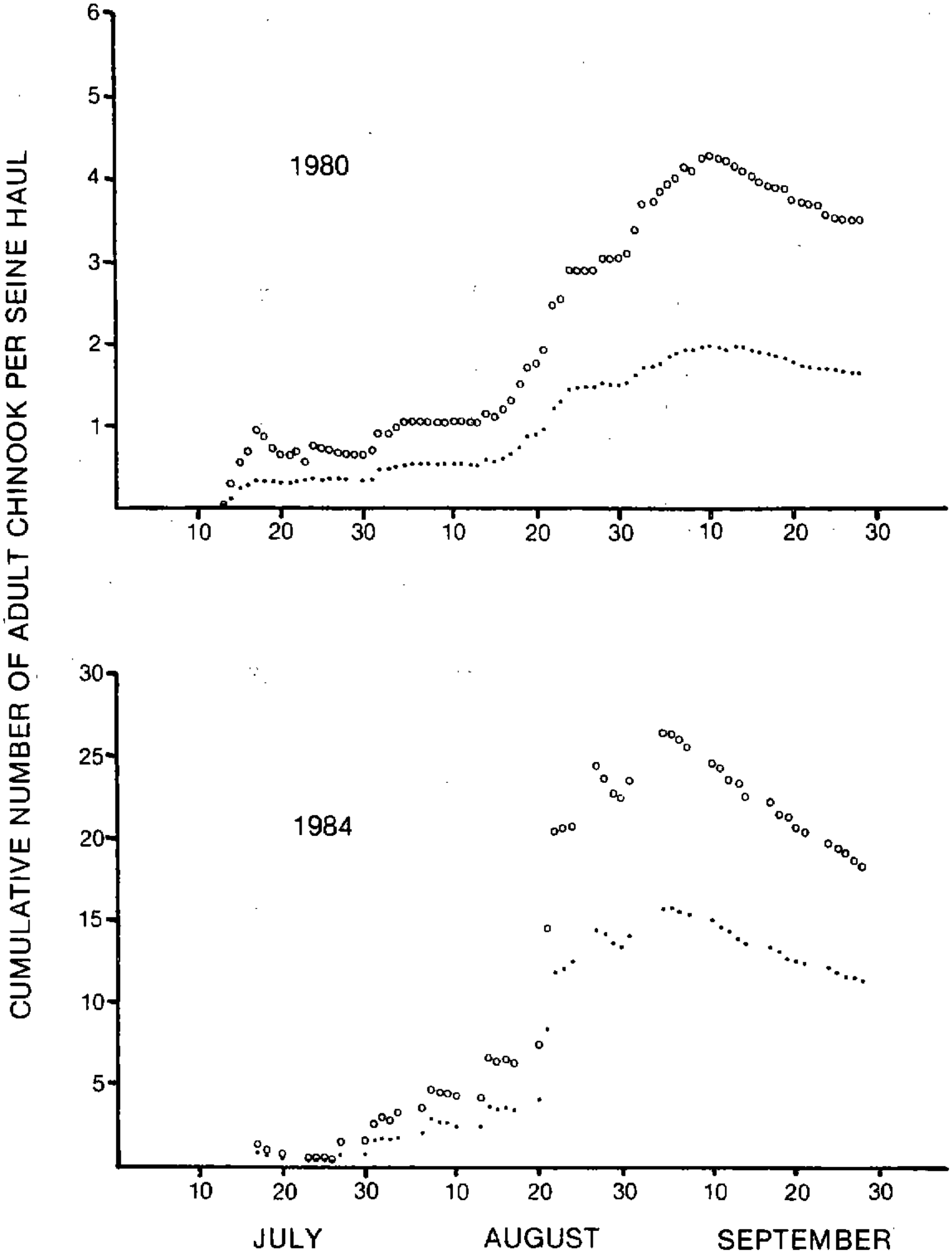


FIGURE 14. Difference in cumulative catch/effort values between peak three sets (○) and all sets (·) for chinook salmon captured in beach seine operations during a high effort (1980) versus a low effort (1984) year.

season peak-three-set C/E value was roughly 2.1 times the total C/E value, while in 1984 it was only 1.6 times the total C/E value.

Bias due to season-to-season variation in the proportion of total effort occurring outside of a defined seasonal run peak was treated by comparing only that portion of the C/E data collected during the peak of each annual run. Seasonal differences in duration of run peak periods may then be considered by comparing the number of days each peak lasted.

To assist in identifying the 1984 fall chinook run peak, daily adult fall chinook C/E values were plotted for the peak three consecutive sets (Figure 15). The run peak period identified in 1984, July 27 through September 7, was defined as that period during which adult C/E values in the peak three consecutive sets consistently exceeded 3.0. The outlying periods contained the fewest number of points (0) greater than this value, while the run peak period itself contained the fewest number of points (6) less than 3.0. The run peak period, then, reflects the major pulses of entering salmon and excludes periods of inconsistent effort expended on the small number of fish entering before and after this period. A summary of 1980-1984 run peak periods and associated C/E values resulting from various data treatments is included in Table 10.

Run-Size Estimation

While the California Department of Fish and Game (CDFG) has prepared annual estimates of fall chinook salmon run sizes within the Klamath-Trinity basin on a post-season basis since 1978, no reliable in-season indices have been developed for use in management of the in-river fisheries. FAO-Arcata biologists began exploring the possibility of utilizing treated catch/effort data from the beach seine program in developing in-season fall chinook salmon run size indices in 1980.

The validity of using C/E data derived through FAO-Arcata field programs in estimating in-season abundance relies on certain assumptions, as detailed in the 1983 Annual Report (USFWS 1984). As noted, the physical morphology and orientation of the south spit beach seine site in 1984 was different than in previous years and apparently contributed to an inflated seasonal C/E value from the sample. This uncontrollable influence may invalidate the assumption that catch per seine haul values in the beach seine operation are comparable between years in relative representation of run size, and therefore limit the utility of C/E data in deriving abundance indices.

Recognizing the stated limitations of the data, several relationships were explored between C/E indices derived, and post season run size estimates provided by the CDFG. Portions of the information on adult fall chinook run sizes provided by CDFG and used in this analysis are based on weir counts, portions on fishery harvest estimates, and other portions on mark and recapture or spawning ground survey data (Table 11).

Run strength indices used in the analysis were developed by multiplying C/E in the peak three sets during the defined annual run peak periods by the seasonal duration of these periods (number of consecutive days) as follows:

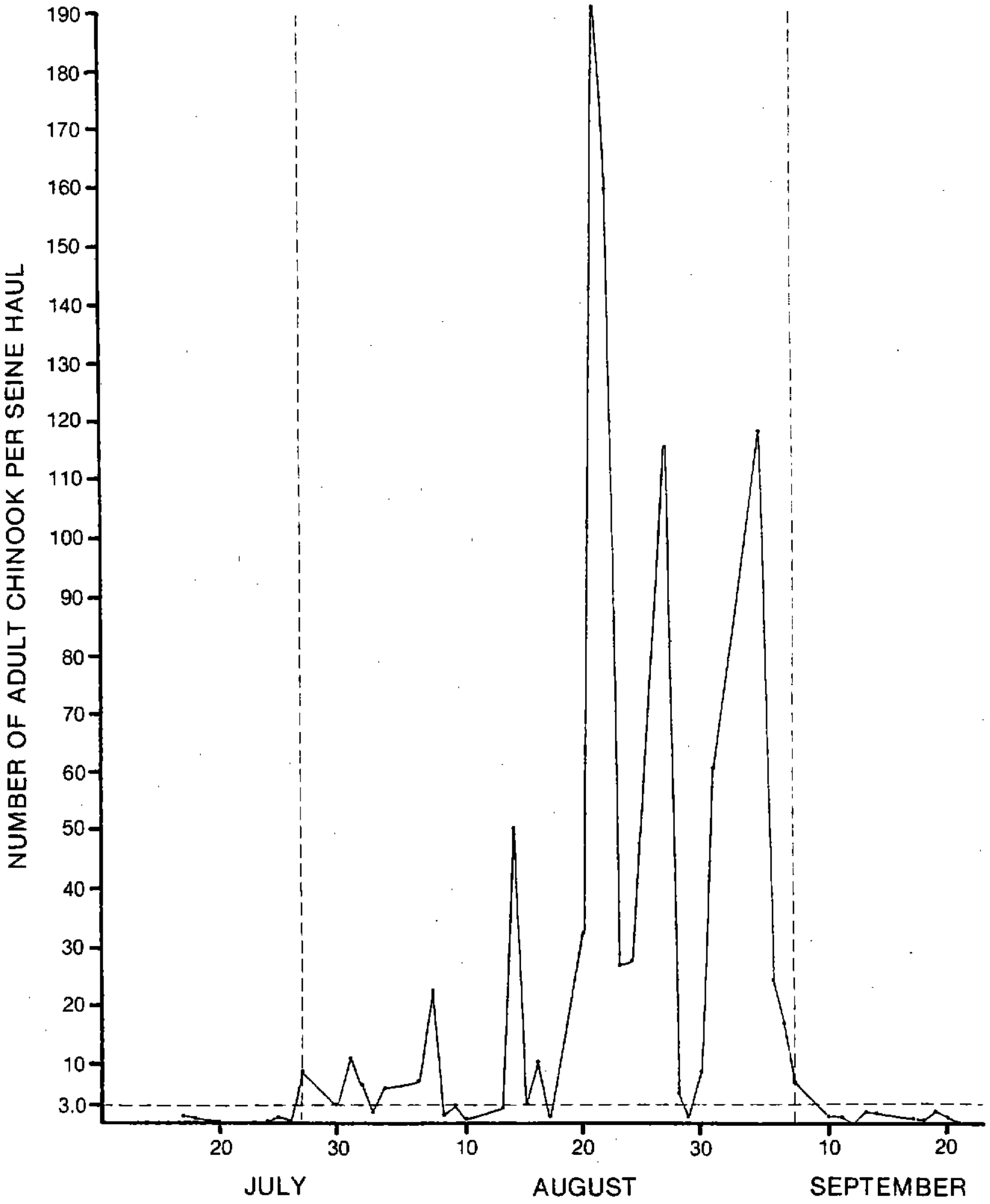


FIGURE 15. Run peak period (7/27-9/07) determined from this figure of daily numbers of adult chinook salmon captured per beach seine haul (peak three sets) in the Klamath River estuary during 1984 operations.

TABLE 10. Summary of catch/effort data for chinook salmon captured during 1980-1984 beach seining operations in the Klamath River estuary.

Timing	Chinook Run Component	YEAR 1980	1981	1982	1983	1984
Total Season		07/13-09/28	07/13-09/25	07/19-09/22	07/15-10/05	07/17-09/28
All Sets	Jack	2.40	1.90	3.04	0.47	1.20
	Adult	1.65	3.92	8.24	2.82	11.31
	All Chinook	4.06	5.82	11.28	3.29	12.51
Peak Three Sets	Jack	4.73	2.97	4.49	0.76	1.98
	Adult	3.41	6.55	12.19	4.46	18.36
	All Chinook	8.14	9.51	16.68	5.22	20.25
Run Peak Period		08/18-09/10	08/18-09/15	08/09-09/09	08/13-09/18	07/27-09/07
All Sets	Jack	5.13	4.21	5.41	0.91	1.86
	Adult	4.11	9.18	14.42	5.48	18.93
	All Chinook	9.24	13.39	19.83	6.39	20.79
Peak Three Sets	Jack	9.90	6.28	8.14	1.32	3.10
	Adult	8.57	14.38	21.80	8.45	31.36
	All Chinook	18.47	20.67	29.94	9.77	34.46

TABLE 11. Post-season run size estimates for Klamath River fall chinook during 1980-1984[1/].

	1980[2/]		1981[2/]		1982[3/]		1983[3/]		1984[3/]	
	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult
Spawning Escapement										
IGH	451	2,412	540	2,055	1,833	8,353	514	8,371	764	5,330
TRH	2,256	4,099	1,004	2,370	3,916	2,063	276	5,765	669	1,902
Subtotal	2,707	6,511	1,544	4,425	5,749	10,416	790	14,136	1,433	7,232
Natural	26,982	21,483	16,507	33,857	16,455	30,112	2,540	31,547	5,368	15,434
TOTAL SPAWNING ESCAPEMENT	29,689	27,994	18,051	38,282	22,204	40,528	3,330	45,683	6,801	22,666
Harvest										
Sport Angler	5,104	2,086	7,252	5,983	12,095	7,686	353	4,342	1,591	2,136
Indian Net	987	12,013	2,465	33,033	1,799	14,482	163	7,890	453	18,484
TOTAL HARVEST	6,091	14,099	9,717	39,016	13,894	22,168	516	12,232	2,044	20,620
TOTAL IN-RIVER RUN	35,780	42,093	27,768	77,298	36,098	62,696	3,846	57,915	8,845	43,286

1/ All estimates from the CDFG except that portion of total run size derived from net harvest data collected by USFWS FAO-Arcata, or HVBC Fisheries Department.

2/ Final estimates for these years.

3/ Estimates preliminary.

Jacks	1980	Run Strength Index	=	9.90	x	24	=	237.60
	1981	Run Strength Index	=	6.28	x	29	=	182.12
	1982	Run Strength Index	=	8.14	x	32	=	260.48
	1983	Run Strength Index	=	1.32	x	37	=	48.84
	1984	Run Strength Index	=	3.10	x	43	=	133.30
Adults	1980	Run Strength Index	=	8.57	x	24	=	205.68
	1981	Run Strength Index	=	14.38	x	29	=	417.02
	1982	Run Strength Index	=	21.80	x	32	=	697.60
	1983	Run Strength Index	=	8.95	x	37	=	331.15
	1984	Run Strength Index	=	31.36	x	43	=	1348.48

Least squares linear regressions were fitted to the run strength indices and post-season run size data from CDFG for both adults and jacks. Of the regression relationships explored between adult C/E indices and in-river run size, none were significant (F-test, $p > 0.05$). Regressions between jack indices and pooled IGH, TRH, and Shasta River weir counts as well as between jack indices and total run-size estimates, however, yielded high r^2 values ($r^2 = 0.89, 0.92$) indicating a significant functional relationship (F-test, $p < 0.05$, Figure 16).

Although accurate in-season adult run-size estimation has not proven to be possible in the last two seasons, the continued significant relationship of jack data to the run strength indices indicates the potential utility of such data for at least two purposes. Jack C/E index data may be used to scrutinize other estimates of jack run strength in the basin on a post-season basis. Secondly, such data can be used in collaboration with beach seine scale sample/cohort analysis data to predict future 3-year-old population levels in the ocean. Further testing of the jack component of the regression model is therefore suggested during 1985.

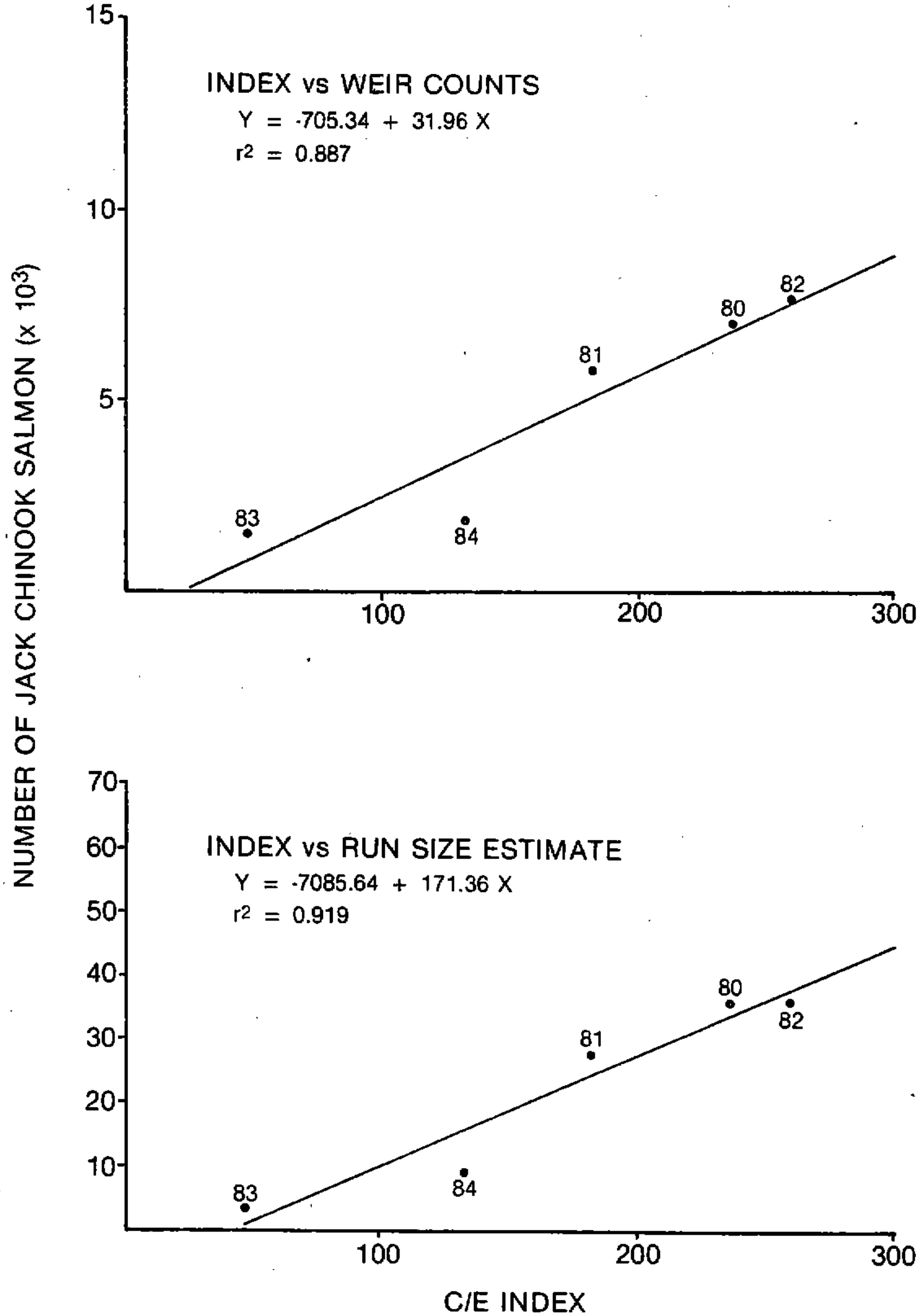


FIGURE 16. Linear relationships between beach seine C/E indices and numbers of chinook returning as jacks during 1980-1984.

AGE COMPOSITION

INTRODUCTION

Continous monitoring of the age composition of a fish stock impacted by major fisheries is essential to sound resource management. Age data, in combination with length and weight measurements, provide information on stock composition, age at maturity, mortality, growth and production. Such information may be used in setting pre-season management goals and regulations. Analyses of these parameters are also useful in judging the results and effectiveness of management practices employed. As part of a continuing effort to evaluate age composition of chinook salmon runs in the Klamath basin, scales were again collected from fall chinook salmon sampled through a beach seining program near the mouth of the Klamath River. A summary of age information collected on fall chinook entering the Klamath since 1979 is presented herein.

METHODS

Percentage age composition of the fall chinook run was determined through scale and length-frequency analysis of data collected in beach seining operations conducted in the Klamath River estuary (see Beach Seining section) during the 1979-1984 return years. Assignment of age group contributions to in-river runs by brood and return year were established by applying the percentage age composition of fall chinook captured in beach seining operations to total Klamath River fall chinook in-river run estimates as reported by the Pacific Fishery Management Council (PFMC 1985).

Age structure of the 1984 fall chinook run was determined through the analysis of scales collected from a sample of 950 chinook salmon captured from July 17 to September 28. This sample represented approximately every other chinook examined in the beach seine and was therefore distributed proportionally to total catch within this time period. As discussed previously in this report, the beach seine site from which the scale sample was collected, occurs downstream of the major in-river fisheries and therefore allows for the sampling of the entire in-river run prior to these fishery impacts. Based on a statistical analysis involving the hypergeometric distribution (Dixon and Massey 1969), a subsample of 661 would have estimated the percentage of 2-, 3- and 4-year-olds within the 1984 run size of 52,131 (PFMC 1985) at the 95% level of precision. The 1984 sample of 950 would therefore estimate 2-, 3- and 4-year-old age composition of the run at an even greater level of precision. For these reasons, the sample is assumed to be representative of the entire 1984 fall chinook run entering the Klamath River.

Cellulose acetate impressions of fall chinook scales were made utilizing a Carver Model C hydraulic laboratory press equipped with two variable temperature heating elements. Impressions were then viewed on a Bell and Howell ABR-1020 dual lens projector. Scale impressions were analyzed independently by two interpreters, with a third reading by an additional interpreter when the initial two readings differed. Scales not aged with confidence after the third reading were excluded from the cohort analysis.

Scales from known age fish (coded-wire-tag recoveries) were used to assist in the age determinations of the sample.

RESULTS AND DISCUSSION

The age composition of fall chinook returning in 1984 showed a dominance of 4-year-old (45.0%), followed by 3- (40.0%), 2- (13.0%) and 5-year-old (2.0%) salmon (Table 12). Most evident in comparing the 1984 and 1983 fall chinook runs was the increased proportion of age 4 fish (31.4% to 45.0%) and the coinciding decrease of age 3 fish (54.3% to 40.0%). The percentage of 2-year-olds for the 1984 return was slightly higher than 2-year-old returns of 1983 (Figure 17). Both return years contain an unusually low percentage of jack or 2-year-old chinook.

Estimates of age group contributions to fall chinook in-river runs during the 1979-1984 return years are presented in Table 13. It should be noted that the California Department of Fish and Game (CDFG) estimates for jack and adult components of the in-river run are not in agreement with USFWS age composition data derived through scale analysis and length frequency information. A decision was made to apply USFWS cohort percentages to CDFG total run size estimates (as presented in PFMC 1985) to remain consistent with the overall age contribution analysis.

In 1984, the returns of age 2 and age 5 fall chinook were 69.2% and 55.4% lower than the 6-year average for their respective age groups. Low 2-year-old contributions for both 1983 and 1984 return years indicate a potential weakness of the 1981 and 1982 brood years. The estimated number (20,852) of 3-year-old chinook returning in 1984 is 29.0% lower than the 1979-1984 average, again indicating an apparent weakness of the 1981 brood. The 1984 return of 4-year-old chinook (23,459) is the second highest return percentage in 6 years, but is only 4.6% higher than the 6-year average.

Since 1976, the 1978 brood has provided the largest contribution (92,845 adults) of in-river fall chinook returns (Figure 18). Dominance of the 1978 year class appears to be attributable to the larger escapement of 71,451 adult fall chinook to the basin in 1978, as compared to 45,683 or fewer in subsequent years.

The 1979 and 1980 brood years appeared to be intermediate in strength compared to the dominant 1978 and depressed 1976 and 1977 broods. Based on a combined 2- and 3- year-old return of 28,819 chinook in 1984, the 1981 brood appears slightly stronger than the poor returns of the 1976 and 1977 broods, yet is still quite weak as previously mentioned. With a 2-year-old contribution of only 6,771 fall chinook, the 1982 brood appears to be weaker than either the 1976 or 1977 year classes.

Based upon the completed returns of the 1977, 1978 and 1979 brood years, the average age composition for fall chinook returning to the basin in 1979-1984 is 31.9% age 2, 37.9% age 3, 27.1% age 4 and 3.0% age 5. Mean ages at return for fall chinook from the 1977, 1978 and 1979 broods are 3.24, 2.94 and 2.85 respectively, averaging 3.01 for the three brood years.

TABLE 12. Percentage age composition of Klamath River fall chinook derived from scale analysis and length-frequency information during the 1979-1984 return years.

Return Year	AGE			
	2	3	4	5 1/
1979	14.4	32.8	46.6	6.2
1980 2/	58.0	17.8	19.1	5.1
1981	32.9	53.6	12.0	1.5
1982	29.1	32.0	36.1	2.8
1983	12.9	54.3	31.4	1.4
1984	13.0	40.0	45.0	2.0
1979-1984 Average	26.7	38.4	31.7	3.2

1/ Includes some 6-year-old fish.

2/ Based on length-frequency data only. No scales collected in the 1980 season.

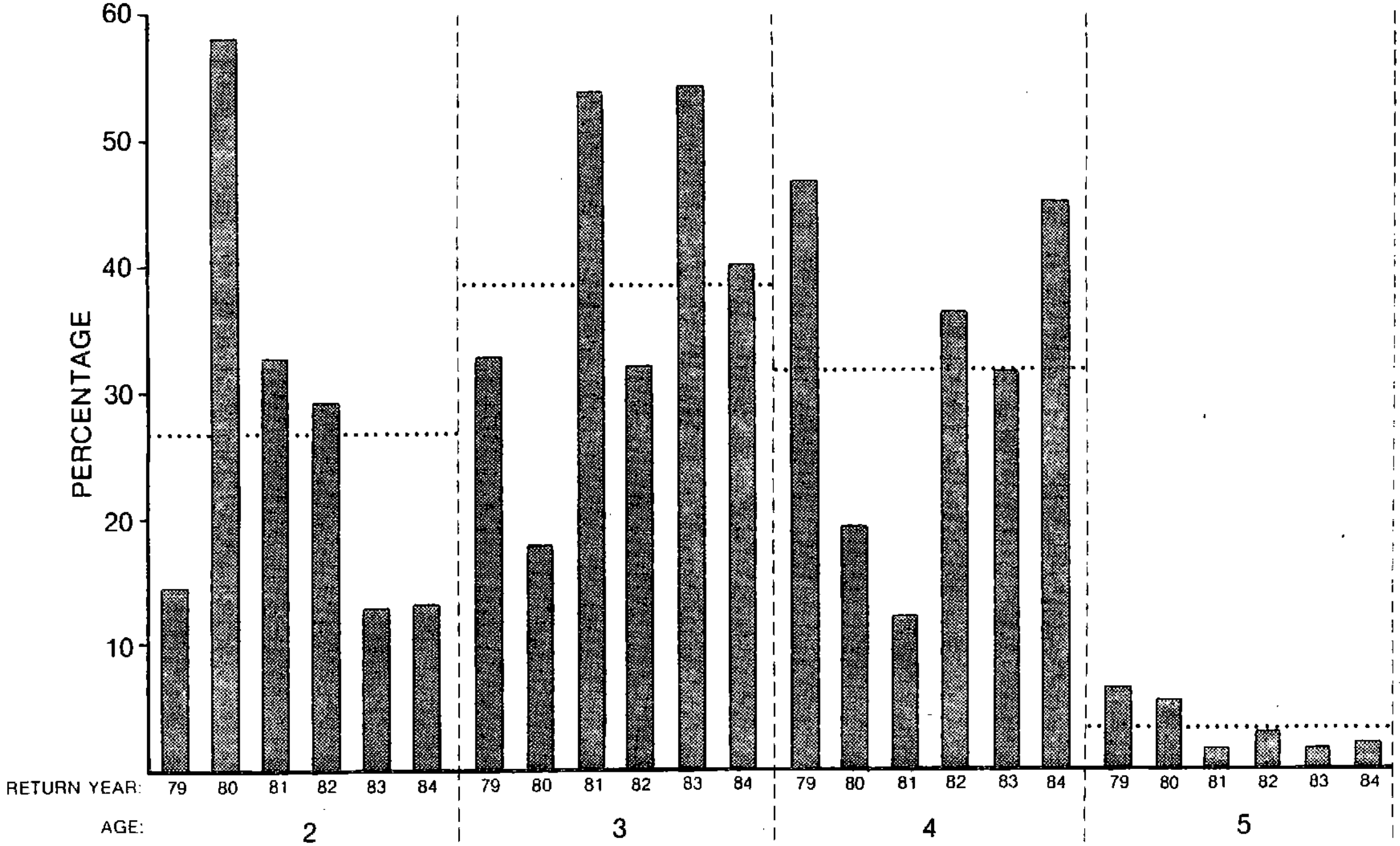


FIGURE 17. Percentage age composition of fall chinook salmon returning to the Klamath River during 1979-1984. Dotted line represents the average return percentage of each age group.

TABLE 13. Estimated number of fall chinook by age entering the Klamath River during the 1979-1984 return years.

Return Year	AGE				Total
	2	3	4	5	
1979	8,867	20,197	28,695	3,818	61,577 1/
1980	45,166	13,861	14,874	3,972	77,873
1981	34,567	56,315	12,608	1,576	105,066
1982	28,749	31,614	35,665	2,766	98,794
1983	7,967	33,536	19,393	865	61,761
1984	6,777	20,852	23,459	1,043	52,131
1979-1984 Average	22,015	29,396	22,449	2,340	76,200

1/ Estimated total and associated numbers for 1979 differ slightly from those published in previous annual reports due to changes in CDFG run size estimates.

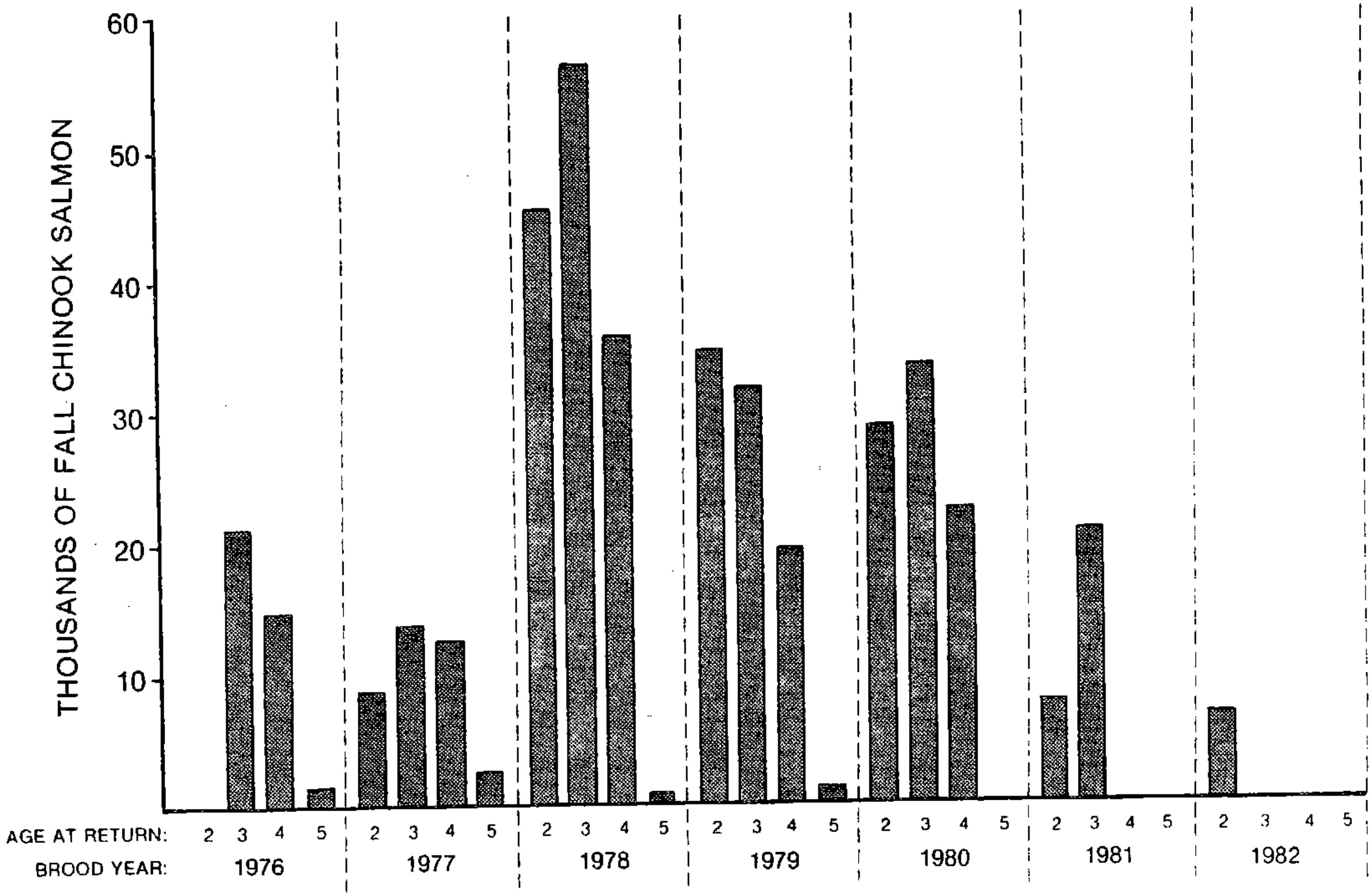


FIGURE 18. Brood year contribution by age of fall chinook salmon to the 1979-1984 Klamath River returns.

Fall chinook returning to the Klamath River in 1984 as 2-, 3-, 4- and 5-year-olds had mean lengths of 45.4, 62.9, 72.6 and 81.1 respectively (Table 14). Mean lengths for all age groups returning in 1984 were significantly smaller (t-test;$p<0.05$) than respective age groups returning in either 1979, 1981 or 1982. Mean lengths for age 2-, 3- and 4-year-olds returning in 1984 were significantly larger ($p<0.05$) than respective age groups returning in 1983. Chinook aged as 5-year-olds in 1984 were slightly smaller in mean length than those 5-year-olds sampled in 1983, but no significant difference ($p>0.05$) could be detected.

The small size of chinook returning in 1983 and 1984 may be largely the result of a reduction in the ocean food supply due to the El Niño current present in coastal waters during 1982-1983. The overall increase in mean length of salmon returning in 1984 as compared to those of 1983 shows the response of Klamath River salmon populations to improved ocean growth conditions in 1984. Further information on this phenomenon and its effects are presented in a subsequent chapter.

TABLE 14. Mean length (cm) of fall chinook returning at each age in 1979 and 1981-1984 return years.

Return Year		AGE AT RETURN 2	3	4	5
1979	$\bar{X} \pm$ 95% CI	48.8 ± 1.3	70.1 ± 0.8	80.3 ± 0.6	88.7 ± 2.0
	n	97	221	314	42
1981	$\bar{X} \pm$ 95% CI	50.2 ± 0.7	68.1 ± 0.8	80.5 ± 1.5	89.0 ± 5.0
	n	176	287	64	8
1982	$\bar{X} \pm$ 95% CI	48.3 ± 0.7	69.3 ± 1.0	83.2 ± 1.0	87.2 ± 4.2
	n	161	177	200	13
1983	$\bar{X} \pm$ 95% CI	41.9 ± 0.8	60.3 ± 0.5	71.5 ± 0.9	82.2 ± 5.5
	n	80	338	195	9
1984	$\bar{X} \pm$ 95% CI	45.4 ± 0.7	62.9 ± 0.4	72.6 ± 0.5	81.1 ± 3.8
	n	123	379	426	19

NET HARVEST MONITORING PROGRAM

INTRODUCTION

Hoopa, Karok and Yurok Indian peoples living along the Klamath and Trinity Rivers have traditionally fished for salmon, steelhead, sturgeon and other species using a variety of fishing gear including weirs, dip nets, spears, and gill nets. Historically, salmon consumption by these people exceeded 907,000 kg (2 million pounds) annually (Hoptowit 1980). For historical accounts of the Indian fisheries see Hoptowit (1980), Bearss (1981) and USFWS (1981).

Regulations governing recent Indian fishing on the Hoopa Valley Reservation (HVR) were first published by the Department of the Interior in 1977, and FAO-Arcata biologists began monitoring net harvest levels on the Reservation in 1978 (USFWS 1981), with efforts focused on fall chinook salmon. Further progress was made in ascertaining net harvest levels with the establishment of a net harvest monitoring station in the lower Klamath River in 1980. Net harvest monitoring operations were expanded upriver beginning in 1981 for Reservation-wide coverage of the net fishery. In 1983 and 1984, FAO-Arcata biologists focused monitoring efforts solely on the Klamath River portion of the Reservation, operating three monitoring stations based near Requa, Omagar Creek and Johnson. Net harvest levels on the Trinity River portion of the HVR were monitored by the Hoopa Valley Business Council Fisheries Department, beginning in 1983.

During 1984, FAO-Arcata biologists employed a stratified random sampling methodology to assess fall season net harvest levels for chinook salmon, coho salmon, steelhead trout, and sturgeon on the Klamath River portion of the HVR in an attempt to improve the accuracy and gauge the precision of the harvest estimates generated. The techniques employed during former seasons yielded point estimates without associated measures of variance. Although they are considered reasonably reliable and accurate, no quantifiable measure of precision can be calculated for estimates made prior to 1984.

METHODS

Net harvest monitoring data were collected and compiled from three contiguous areas (Estuary, Middle Klamath, and Upper Klamath) of the Klamath River portion of the HVR in 1984 (Figure 19). The Estuary Area was defined as the lower 6 km of the river from the mouth to the crossing of the Highway 101 bridge. The Middle Klamath comprised the next 27 km of river from the crossing of the Highway 101 bridge to Surpur Creek, 33 km upstream from the mouth. The Upper Klamath Area included the next 37 km stretch of river from Surpur Creek to Weitchpec. Methods utilized for each harvest period and area follow.

Fall Fishery

The design employed by FAO-Arcata biologists in 1984 involved a stratified random sampling technique with an optimum allocation of sampling effort based on the available data and associated variances. The actual estimate is

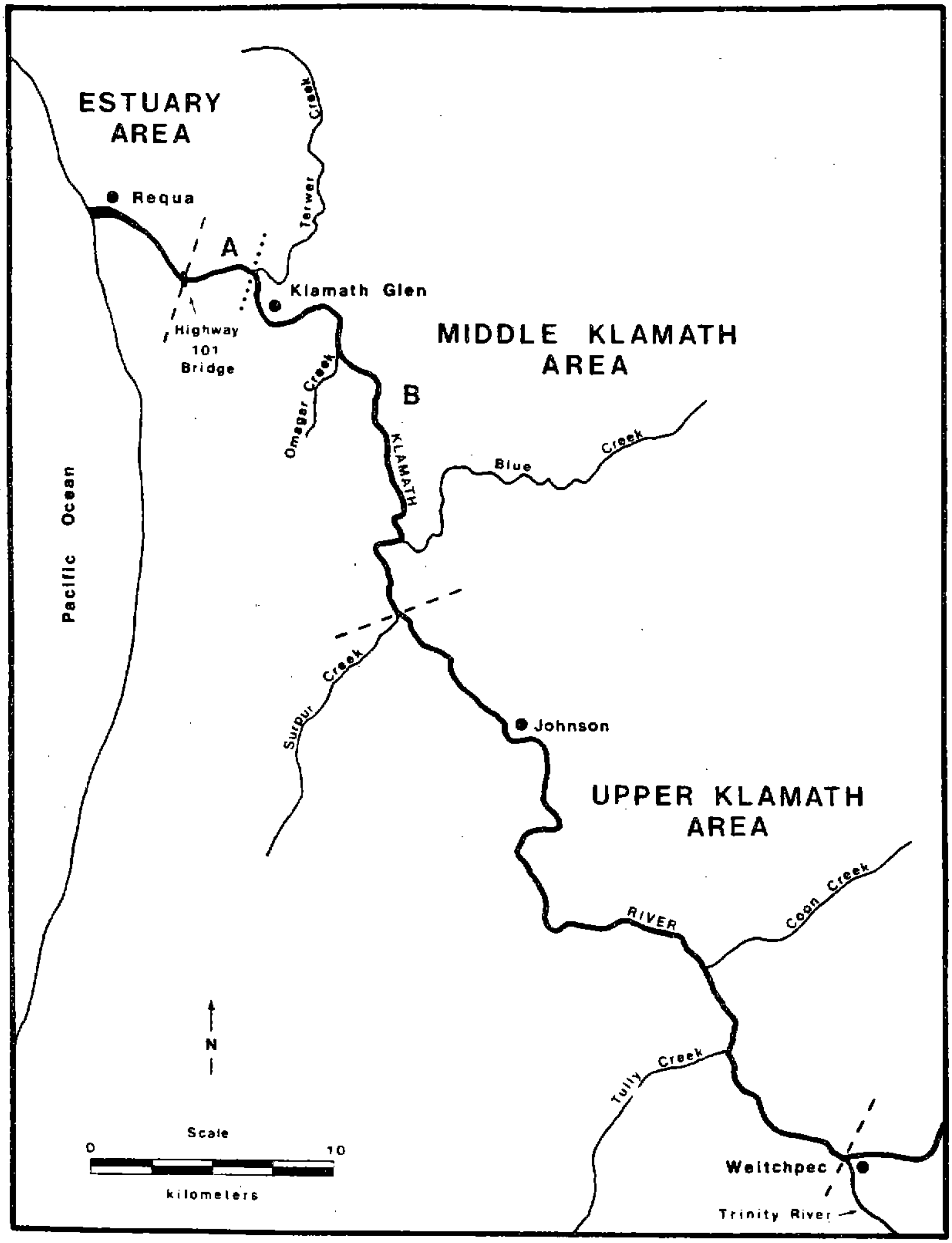


FIGURE 19. Net harvest monitoring areas for the Klamath River portion of the Hoopa Valley Reservation in 1984.

comprised of two parts: an estimate of total effort from the net counts and an estimate of average catch per net for each area and net type. Each part of the estimate has an associated variance estimate. These variances are combined to give an estimated daily variance. The daily estimates of catch and variance are expanded to total estimates of catch variance by area, net type and time period, usually semi-monthly. Following is the methodology utilized for monitoring the fall chinook harvest in each area and subsequent data analysis.

Estuary

Two field crews, consisting of one biologist and one Indian technician each, monitored the Estuary Area fishery daily from July 18 to September 30. Indian fishers were contacted from 5:00 PM to 1:00 AM or later, and 6:00 AM to 9:00 AM. Spot surveys were also made from 9:00 AM to 5:00 PM on days when the fishery was open during daytime hours (Wednesday through Sunday). Field crews conducted instantaneous net counts in an index area extending from below the Requa docks to Salt Creek (Figure 20) every 2 hours when monitoring the fishery. A total net count of the Estuary Area was taken once daily, just prior to dark, and coincided in timing with the index count for that 2-hour time interval. Indian fishers were interviewed to obtain information on number of fish caught, species identification, mesh size, and number of nets and hours fished. Fall chinook sampled in the net fishery were measured to the nearest centimeter fork length, examined for tags and fin-clips, and inspected for seal or otter-bite damage. A subsample of chinook in the Estuary Area were weighed to the nearest pound and these weights were then converted to kilograms. Snouts were removed from adipose fin-clipped fish for subsequent coded-wire tag identification. Indian fishers not contacted on the river were interviewed later at their residences or camps.

Middle Klamath Area

The Middle Klamath Area was monitored on a 4- to 5-day-per-week basis from August 1 to October 15 by a two man crew, consisting of one biologist and one Indian technician, working from a camp near Omagar Creek. To monitor the set net fishery, boat surveys were made during the early daylight hours (6:00 AM-9:00 AM). Once a day at first light before crews began sampling the set net catch, instantaneous net counts were made in the set net index area which extended from Resighinni Pool to Lamms Riffle (Figure 21).

To monitor the drift net fishery, boat surveys were conducted from 9:00 PM to 1:00 AM when drift netting typically occurs. Instantaneous drift net counts were conducted in the drift net index area, extending from Klamath Glen to Lower Lamms Riffle (Figure 21). These index net counts were made every 2 hours during the time when the crew was monitoring the drift net fishery. A total drift net count of the Middle Klamath Area was taken in the evening hours by boat twice a week, on one weekday and one weekend day. Total drift net counts coincided with the 9:00 PM index count. Interviews with drift and set net fishers were conducted in a like manner to those in the Estuary Area.

Upper Klamath Area

The Upper Klamath Area was monitored on a 4- to 5-day-per-week basis from August 1 to October 31 by a two man crew working out of a camp near

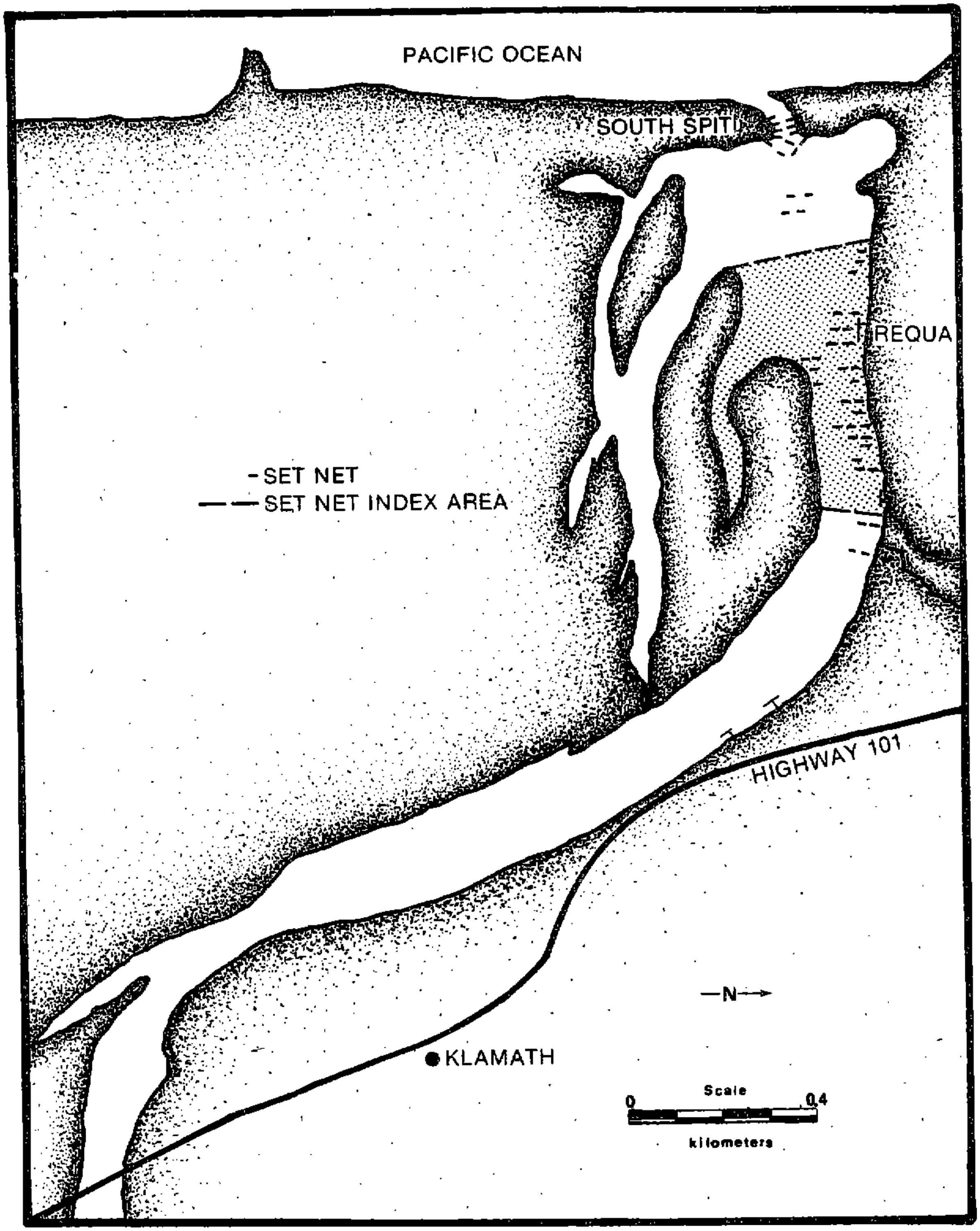


FIGURE 20. Set net index area and typical set net placement in the Estuary Area during the 1984 fall chinook salmon run.

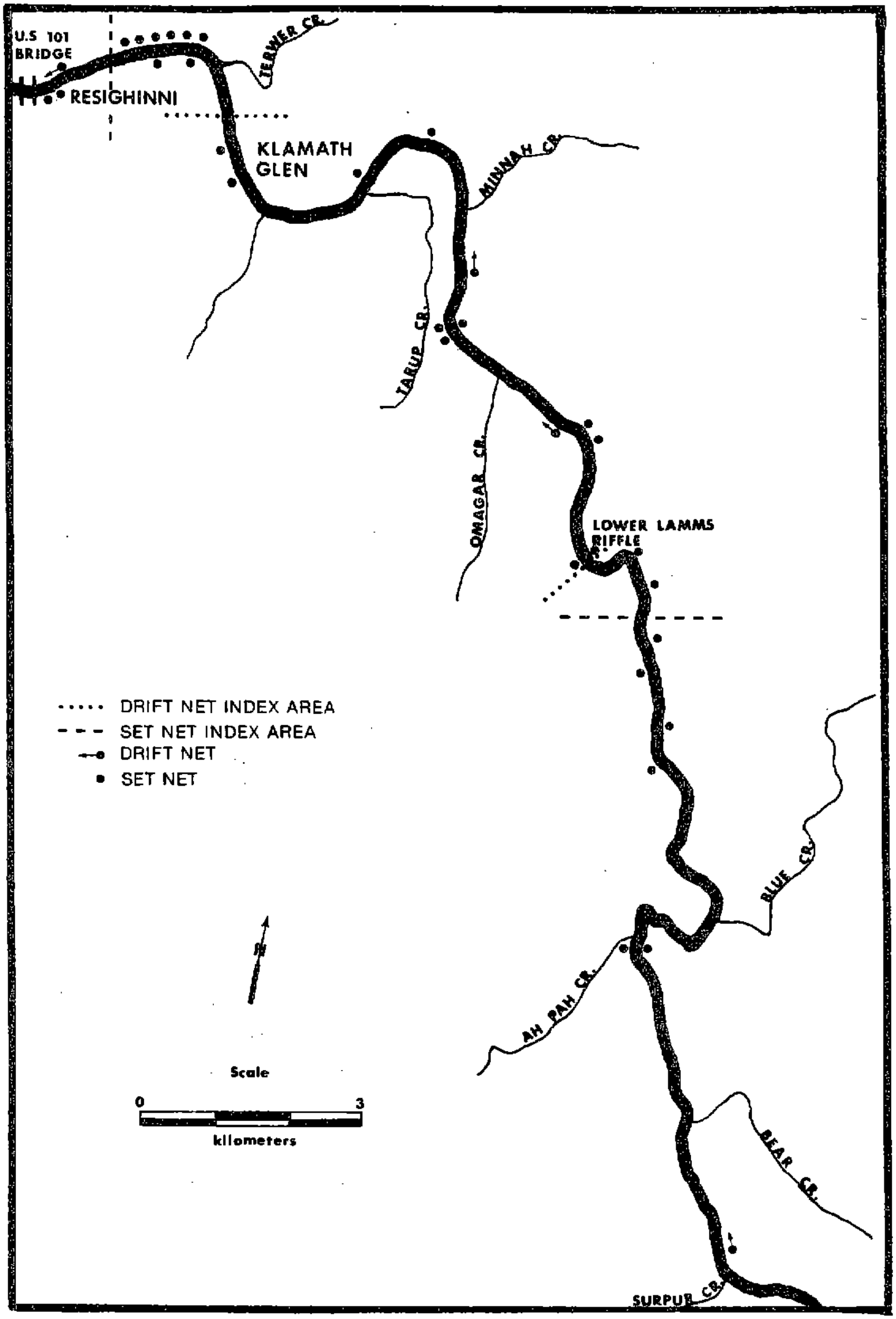


FIGURE 21. Set net index area, drift net index area and typical net placement pattern in the Middle Klamath Area during the 1984 fall chinook salmon run.

Pecwan Creek. As in the Middle Klamath Area, the field crew, made up of one biologist and one Indian technician, conducted an early morning (6:00 AM-9:00 AM) boat survey of the set net fishery and later interviewed fishers at their residences who were not contacted earlier on the river. Instantaneous index set net counts were made in an area extending from Midstream Rocks to Young's Bar (Figure 22) at daybreak each day during the sampling period. The drift net fishery was monitored during the evening hours (9:00 PM to 1:00 AM) in the same manner as the Middle Klamath Area. Instantaneous index drift net counts were conducted in an area downstream of Tectah Creek to an area below Mettah Creek (Figure 22). As in the Middle Klamath Area, index net counts were made every 2 hours during the period when the crew was monitoring the fishery. A total count of drift nets was conducted twice a week, on one weekday and one weekend day, for the Upper Klamath Area. As in the Middle Klamath Area these total counts coincided with the 9:00 PM index count. Interviews with Indian fishers and sampling of the catch were conducted in a similar manner to the Estuary and Middle Klamath Areas.

Aerial Surveys

To obtain total net counts for the set net fishery in both the Middle Klamath and Upper Klamath Area, aerial surveys were conducted approximately twice a week at dawn to coincide with index counts conducted by field crews. These flights generally originated at Weitchpec and proceeded downstream, terminating at the Highway 101 bridge near Klamath. Because of weather conditions, flights were sometimes conducted from the Highway 101 bridge upstream to Weitchpec.

Data Analysis

Definitions and notations for all equations presented herein are summarized as follows:

a = Number of fishing days available in the time period.

$\bar{C}$ = Daily mean catch per net.

$\hat{C}_i$ = Estimated catch for the ith day.

$\hat{C}_p$ = Estimated catch for the pth period.

s = Number of days sampled in the time period.

t = t value at the 95% level.

$\hat{Y}$ = Estimated daily total number of nets fished.

$\hat{V}(\hat{C}_i)$ = Estimated variance of daily catch.

$V(\bar{C})$ = Variance of the mean catch per net.

$\hat{V}(\hat{C}_p)$ = Estimated variance of catch for the pth period.

$V(C_s)$ = Daily variance of catch.

$\hat{V}(\hat{Y})$ = Estimated variance of daily total number of nets fished.

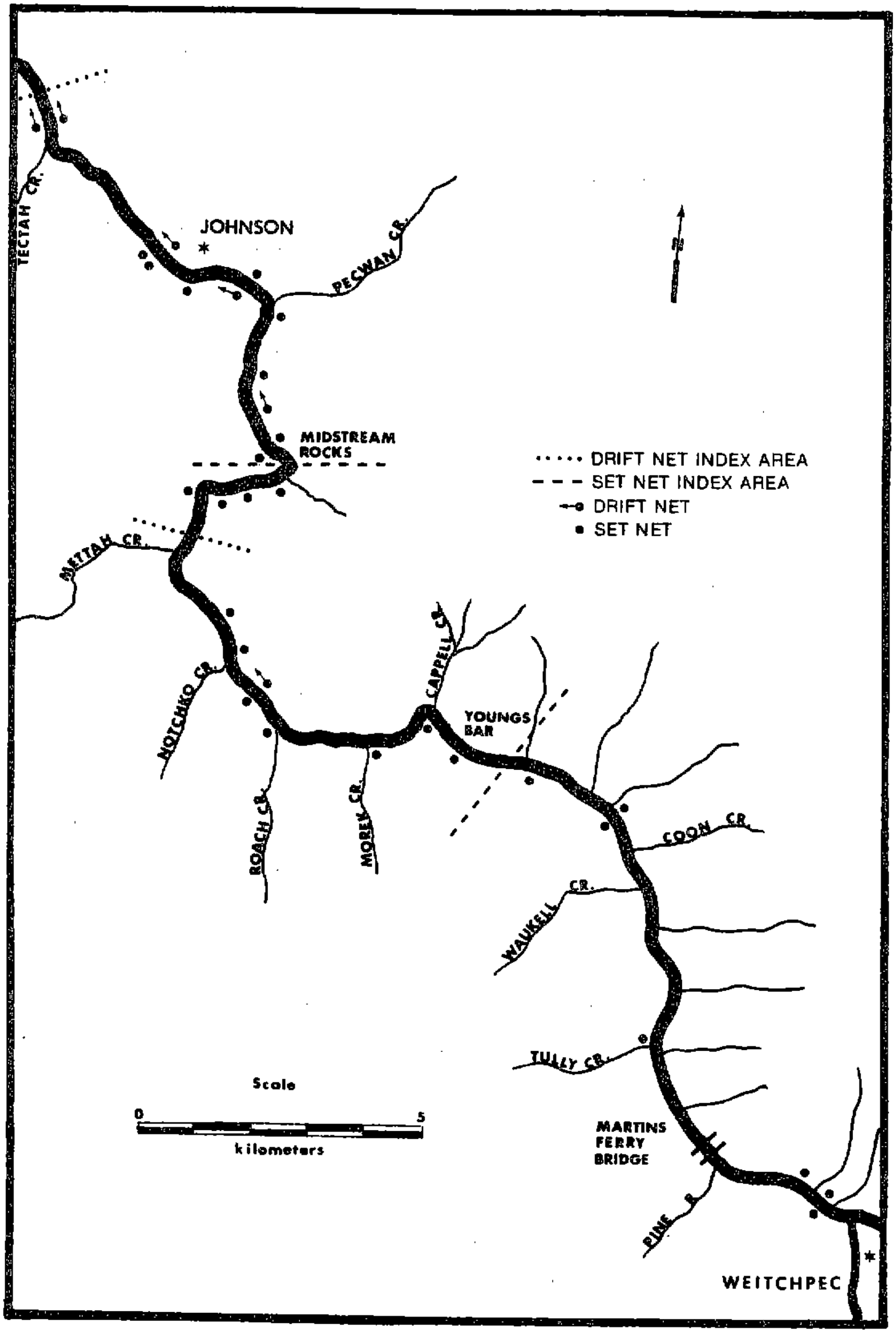


FIGURE 22. Set net index area, drift net index area and typical net placement pattern in the Upper Klamath Area during the 1984 fall chinook salmon run.

Daily estimates ($\hat{C}_i$) of catch by species were calculated by multiplying daily mean catch per net values by the respective estimated daily total number of nets fished (Hankin personal communication):

$$(1)\quad \hat{C}_i = (\hat{Y})(\bar{C})$$

Since the harvest above the Estuary Area was not sampled every day fishing occurred, the harvest was estimated for time periods, usually semi-monthly, using the equation:

$$(2)\quad \hat{C}_p = (\hat{C}_i)\ \frac{a}{s}$$

These semi-monthly estimates of catch were summed to yield the season harvest estimate.

The variance associated with daily catch estimates was calculated by using the equation (Goodman 1960):

$$(3)\quad \hat{V}(\hat{C}_i) = (\bar{C})^2\,[\hat{V}(\hat{Y})] + (\hat{Y})^2\,[V(\bar{C})] - [\hat{V}(\hat{Y})]\,[V(\bar{C})]$$

Because the catch variance is estimated on a daily basis, it must be expanded to include days fished but not sampled. The variance associated with the catch estimate for a time period is calculated by the equation (Cochran 1977):

$$(4)\quad \hat{V}(\hat{C}_p) = \frac{a(a-s)\quad(\hat{C}_i - \bar{C})}{s(a-1)} + \frac{a\,[\,V(C_s)]}{s}$$

Once the estimate and associated variance were calculated for a period, the corresponding 95% confidence interval was calculated by:

$$(5)\quad 95\%\ \text{Confidence Interval} = \pm\,(t_{.975})\sqrt{\frac{\hat{V}(\hat{C}_p)}{a}}$$

Catch per effort values for the three Klamath River areas were derived from the sum of the daily catch checked divided by the sum of the daily effort checked, for the respective areas.

A catch per net index for the Estuary Area was developed to compare yearly variations in catch/effort data within a fixed time period during which most of the catch had occurred. The time period from August 10 to September 15 was used for the index. In the past 5 years, at least 75% of the yearly catch was taken during this period. Catch per net values during this period were calculated from the sum of the estimated daily catch divided by the estimated daily total net count. This treatment will allow for direct comparison of catch per net values between 1984 and previous years.

Spring Fishery

FAO-Arcata personnel, operating from a camp at Klamath Cove RV Park, located near the river mouth at the southern edge of the estuary, monitored the Estuary and Middle Klamath Areas on a periodic basis during the period April 1 through July 17. Personnel operating from a camp near Pecwan Creek monitored the Upper Klamath Area during the same period.

During the spring monitoring period, Indian fishers were contacted while in their boats, at their riverside camps, or at boat landings in the area. Information obtained included number of fish caught, species identification, mesh size, and number of nets fished. Chinook sampled in the net fishery were measured to nearest centimeter fork length, examined for tags and fin-clips, and inspected for seal or otter bite damage. Snouts of fish exhibiting an adipose fin-clip were recovered for subsequent coded-wire tag identification. River surveys, including net counts, were scheduled to coincide with hours when fishers typically checked their nets. Indian fishers not contacted on the river were later interviewed at their residences.

Procedures used in estimating net harvest levels for the three Klamath monitoring areas during the spring fishing period of 1984 were similar to those of previous years. Estimated daily and monthly net harvest levels were derived by: (1) summing numbers of chinook measured, seen but not measured, and reported caught by reliable sources, and (2) dividing these respective sums by the estimated percentage of net harvest these sums were judged to represent. These judgements were based on net counts, a network of contacts on the reservation and on intimate knowledge of the net fisheries. Spring chinook harvest estimates were determined monthly for each of the three areas.

RESULTS AND DISCUSSION

Fall Chinook

FAO-Arcata biologist examined over 3,800 fall chinook salmon harvested by Indian fishers on the Klamath River portion of the HVR in 1984. Of these, 3,723 were mark sampled for tags and fin-clips and 3,296 were measured to fork length. Net harvest in the Klamath River portion of the reservation was estimated at 17,815 $\pm$1,268 fall chinook salmon (Table 15), including 17,500 adults ($\geq$53 cm) (98.2%) and 315 jacks (<53 cm). Among the three monitoring areas, two-thirds (67.4%) of the catch occurred in the Estuary Area with an estimated harvest of 12,010 salmon. Jacks comprised 1.1% of the estuary catch, representing approximately 132 salmon. The Middle and Upper Klamath Area fisheries comprised 16.2 and 16.4% of the adult harvest, representing 2,888 and 2,917 salmon respectively. Jacks accounted for a respective 2.8 and 3.5% of the Middle and Upper Klamath Area catches, representing approximately 81 and 102 salmon (Table 16).

TABLE 15. Semi-monthly set and drift net harvest estimates of fall chinook salmon captured in the three Klamath River monitoring areas of the Hoopa Valley Reservation in 1984.

Time Period	NET HARVEST MONITORING AREA Estuary	Middle Klamath Set Net	Middle Klamath Drift Net	Upper Klamath Set Net	Upper Klamath Drift Net	Semi-Monthly Totals (All Areas)	Cumulative Seasonal Total
July 16 - 31	**460** 1/ 45 2/ 9.8% 3/ 206 4/	**0** - - -	**0** - - -	**0** - - -	**0** - - -	**460**	**460**
August 1 - 15	**664** 46 6.9% 390	**57** 5 8.8% 21	**8** 2 25.0% 2	**47** 5 10.6% 16	**0** - - -	**776**	**1,236**
August 16 - 31	**6,642** 314 4.7% 2,815	**492** 63 12.8% 249	**46** 10 21.7% 30	**518** 33 6.4% 249	**417** 80 19.2% 178	**8,115**	**9,351**
September 1 - 15	**4,173** 202 4.8% 1,829	**1,541** 146 9.5% 947	**357** 42 11.8% 148	**618** 40 6.5% 429	**697** 76 10.9% 287	**7,386**	**16,737**
September 16 - 30	**71** 7 9.9% 38	**289** 33 11.4% 112	**90** 18 20.0% 15	**193** 30 15.5% 96	**358** 56 15.6% 84	**1,001**	**17,738**
October 1 - 15	**0** - - -	**8** 3 37.5% 2	**0** - - -	**15** 3 20.0% 12	**10** 2 20.0% 8	**33**	**17,771**
October 16 - 31	**0** - - -	**0** - - -	**0** - - -	**39** 6 15.4% 11	**5** 1 20.0% 2	**44**	
Area Season Total	**12,010** 614 5.1% 5,278	**2,387** 250 10.4% 1,331	**501** 72 14.4% 195	**1,430** 117 8.3% 813	**1,487** 215 14.4% 559		**17,815** 1,268 7.1% 8,176

1/ Harvest estimate.
2/ 95% Confidence interval.
3/ Confidence interval percentage.
4/ Accounted number of fall chinook.

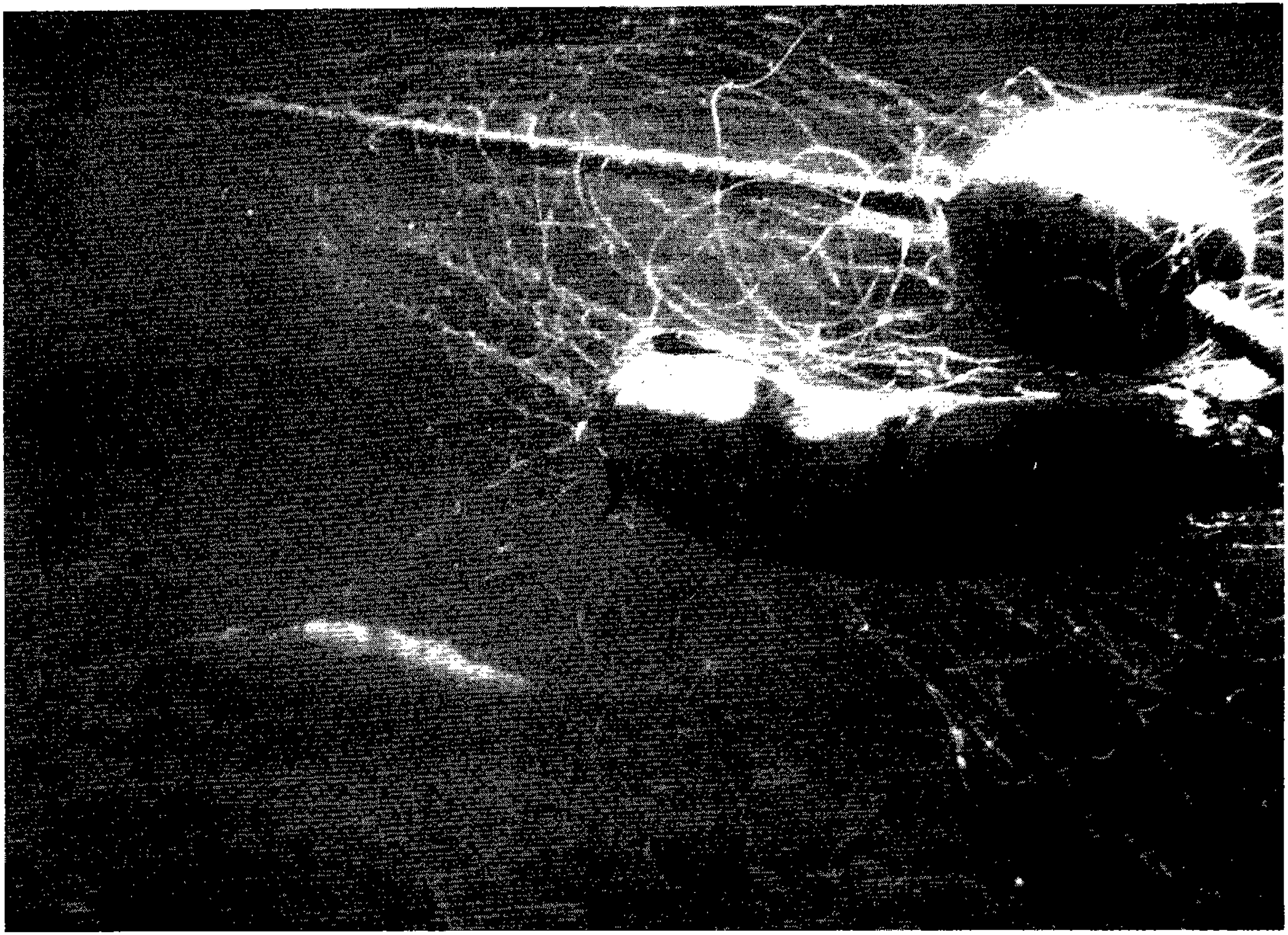


PLATE 4. Chinook salmon captured by gill net in the Klamath River (photograph courtesy of Leo Millan).

Most of the salmon harvested in the Estuary Area were taken from August 22 to September 15 with peak harvest occurring on August 26 (Figure 23). During this time period, daily catch estimates for fall chinook ranged from 0 to 1,420, with an average of 482. Catch/effort during this period ranged from 0.18 fish per net to 13.32 fish per net with an average of 5.51 fish per net.

The Estuary Area fishery rebounded this year with a catch of 12,010 chinook after a low harvest of 812 in 1983. Catch per net indices show the Estuary Area harvest rate for 1984 at 5.49, this value is over 4 times the 1983 figure of 1.21, the lowest index, but only one-third the 1981 value of 15.49, the highest index in the 5-year data base (Table 17).

TABLE 16. The number and percentage of jack and adult fall chinook caught in the net fishery on the Klamath River portion of the HVR in 1984.

Area	Jack	(%)	Adult	(%)	Total	(%)
Estuary	132	(1.1%)	11,878	(98.9%)	12,010	(67.4%)
Middle Klamath	81	(2.8%)	2,807	(97.2%)	2,888	(16.2%)
Upper Klamath	102	(3.5%)	2,815	(96.5%)	2,917	(16.4%)
Total All Areas	315	(1.8%)	17,500	(98.2%)	17,815	(100.0%)

TABLE 17. Catch per net indices of fall chinook salmon harvested in the Estuary Area of the Klamath River during 1980-1984.

Time Period	Year	Index	Percentage of Area Harvest
August 10 - September 15	1980	7.47	90
	1981	15.49	82
	1982	3.74	83
	1983	1.21	76
	1984	5.49	92

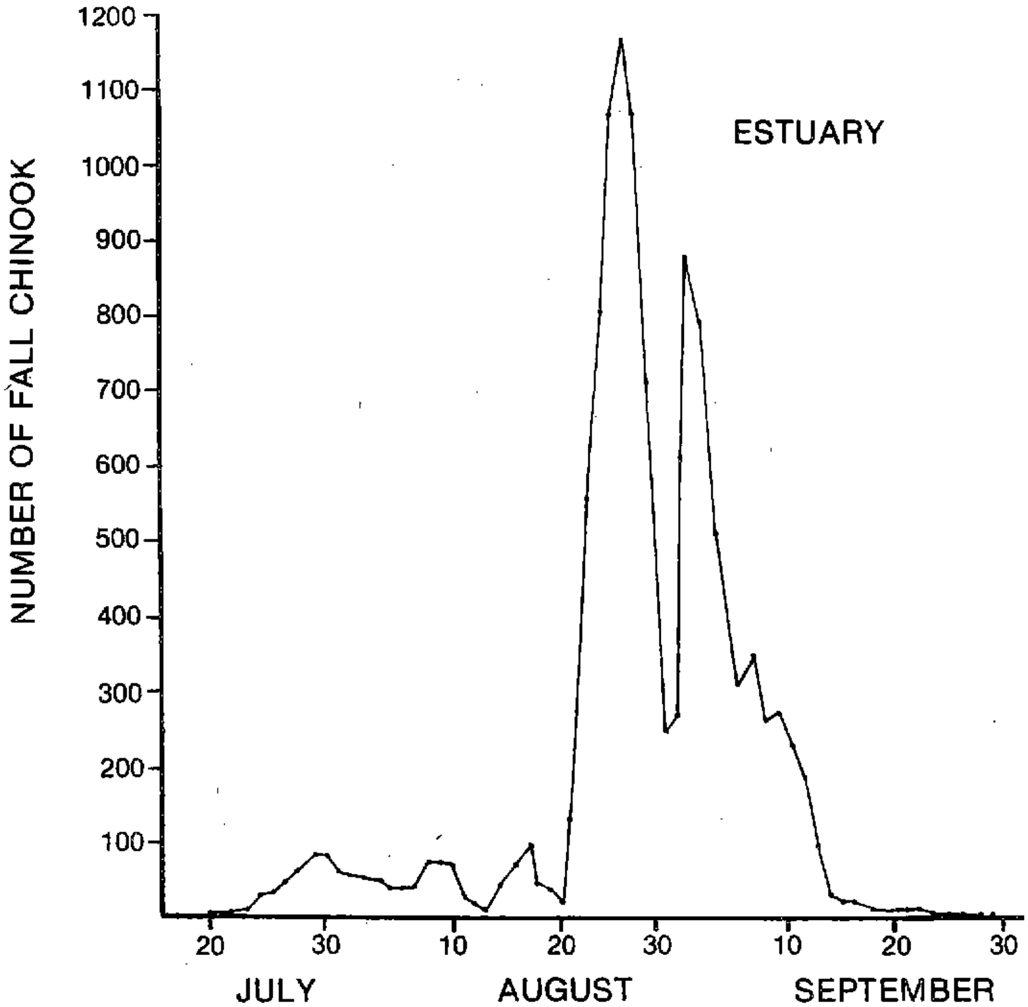


FIGURE 23. Three-day moving average of the estimated number of fall chinook caught by Indian fishers in the Estuary Area of the Hoopa Valley Reservation in 1984.

Low river flow appeared to be the primary influencing factor in the success of the 1984 Estuary Area net fishery. Annual seasonal catch per effort levels by the Indian netters in the Estuary area were negatively correlated to mean Klamath River summer flows (Figure 24). Higher flows impact the net fishery by creating more turbulent currents which reduce the amount of time a net will properly fish without being pulled out of the vertical fishing position or pulled off the bottom. The increase in the volume of water in the estuary during high flow periods presumably make it less likely for fish to encounter the nets.

In 1984 fall chinook salmon entered the Estuary Area fishery earlier than in most previous years (Figure 25). The 1984 peak harvest occurred on the same day (August 26) as 1980 and 5, 10 and 12 days earlier than in 1981, 1982,and 1983 seasons respectively.

Most of the fall chinook harvest in the Middle Klamath set net fishery took place from August 19 to September 21 when 89% of the harvest occurred, with peak harvest taking place between August 31 and September 3 (Figure 26). During this 4-week period daily catches averaged 73, and ranged from 14 to 429 chinook; the peak harvest day was September 2. Daily catch per effort values for this time period ranged from 0.7 to 15.8 fish per net and averaged 5.1 fish per net.

The majority of the fall chinook salmon harvest in the Middle Klamath drift net fishery took place from August 31 to September 7 (Figure 26). During this one week 63% of the total drift net harvest was taken with daily catches ranging from 10 chinook to 160 and averaging 45. The peak catch occurred on September 2 when 160 chinook were taken. This coincides with the peak harvest in the Middle Klamath set net fishery. During the one week peak period the average catch per effort was 20.9 chinook per net with values ranging from 6 chinook per net to 81 chinook per net.

In the Upper Klamath set net fishery, the majority of the harvest occurred from August 17 to September 21 when 90% of the chinook were taken. The peak harvest occurred on September 9 (Figure 26). During this period the average daily catch was 41 chinook with the range of catches 13 to 134 salmon. Catch per effort values ranged from 0.6 chinook per net to 5.1 chinook per net averaging 2.4 chinook per net.

Most of the chinook harvest in the Upper Klamath drift net fishery were taken during the 4-week period, August 23 to September 23, when 88% of the harvest took place. The range of daily catches during this time was 0 to 138 chinook with 47 being the average. Catch per effort values averaged 9.3 fish per net with values ranging from 0 fish per net to 18 fish per net.

River flow does not appear to be a major influence in the success of the upriver fisheries (Figure 24). Annual seasonal catch per effort levels for the Indian fishers in the Upper Klamath Area show little correlation with mean summer flows.

The length-weight relationship Log W=-4.107 + 2.637 Log L was determined for chinook salmon captured in the Estuary Area fishery, based on a sample of 162 fish ranging in fork length from 37 to 99 cm and in weight from 0.9 to 15.75 kg (Figure 27). Chinook jacks taken in the Klamath net fishery

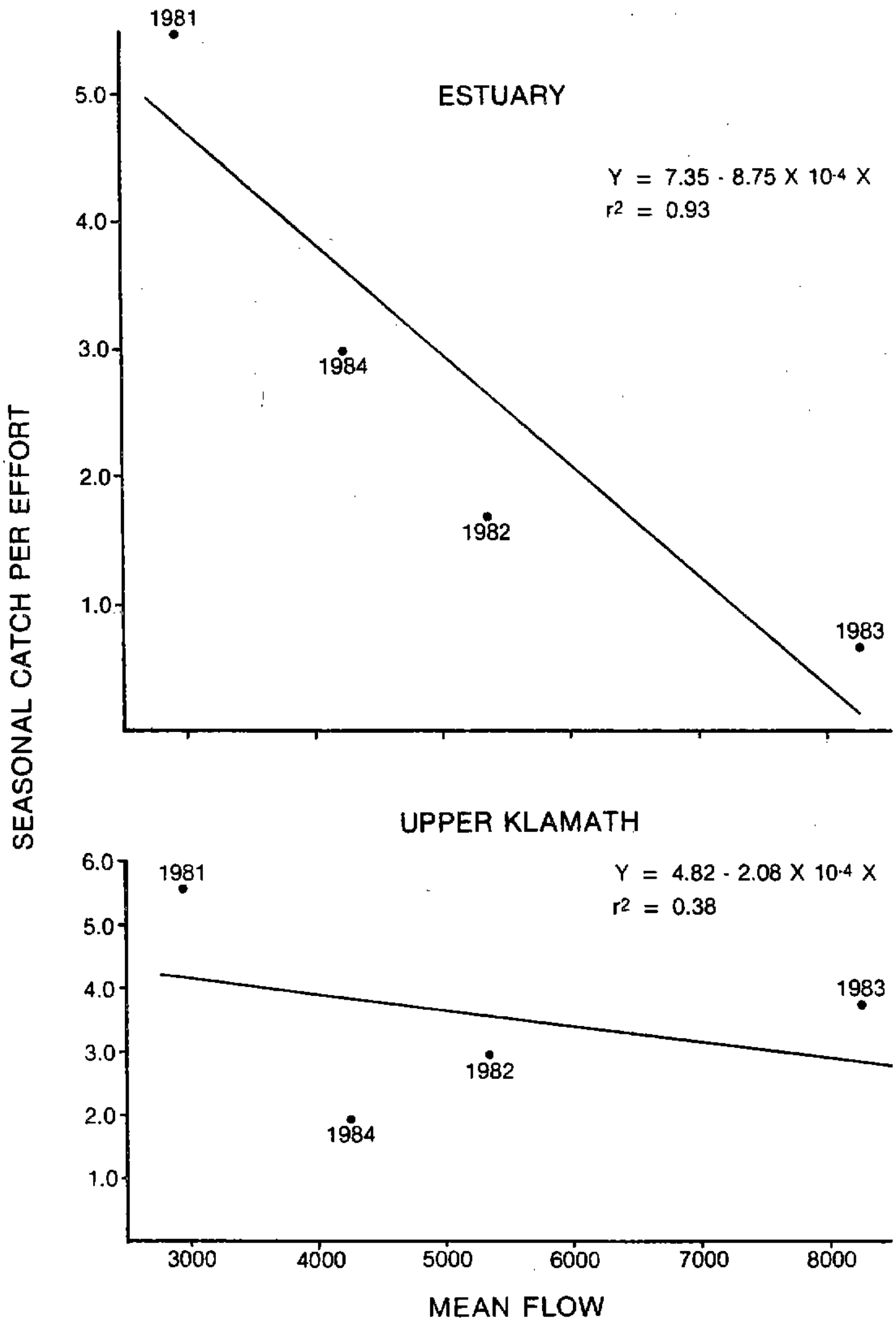


FIGURE 24. Linear regressions of seasonal catch per effort indices on the mean July, August and September flows in the Klamath River at Klamath Glen.

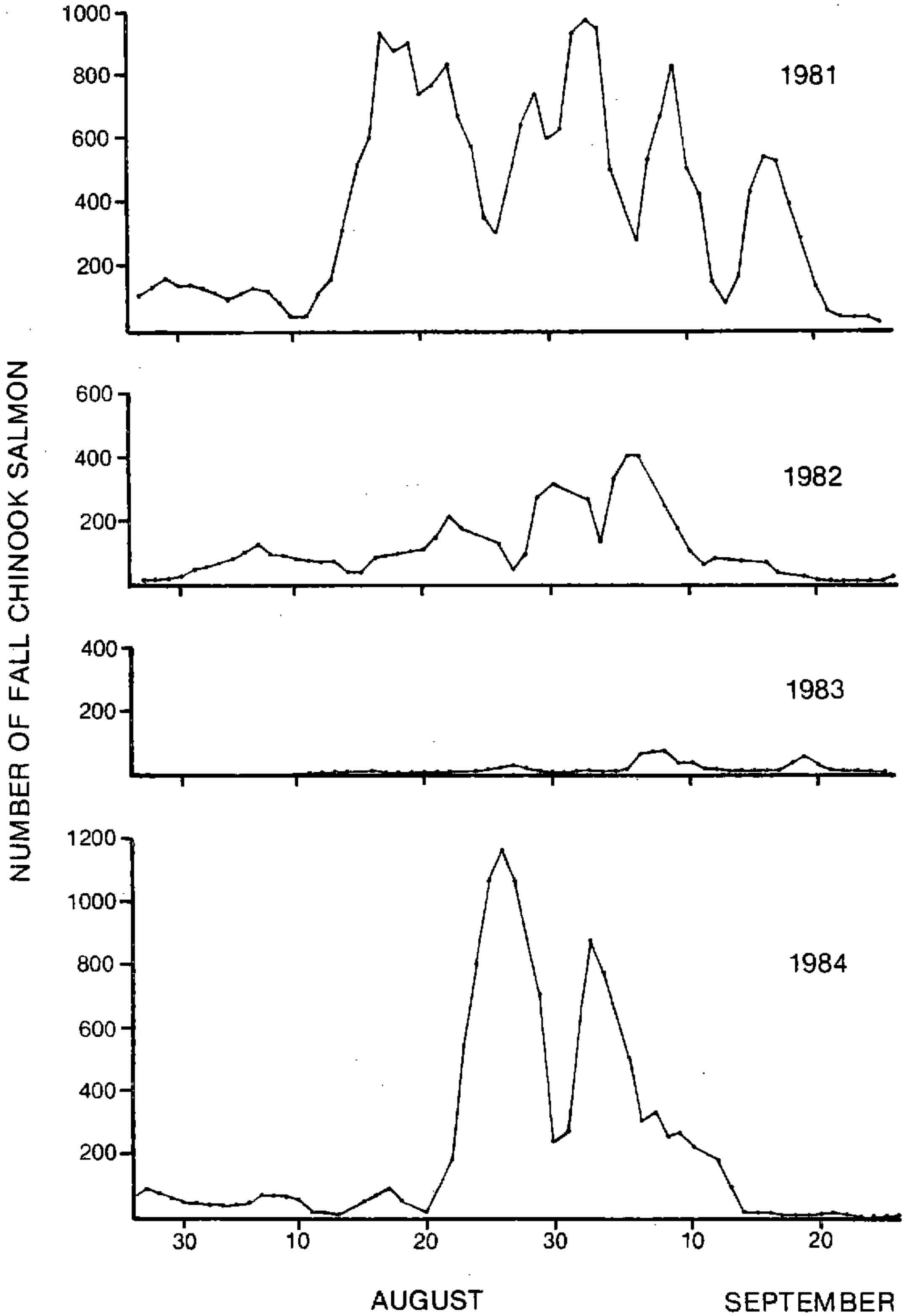


FIGURE 25. Three-day moving averages of the estimated numbers of fall chinook salmon caught by Indian fishers in the Estuary Area of the Klamath River during 1981-1984.

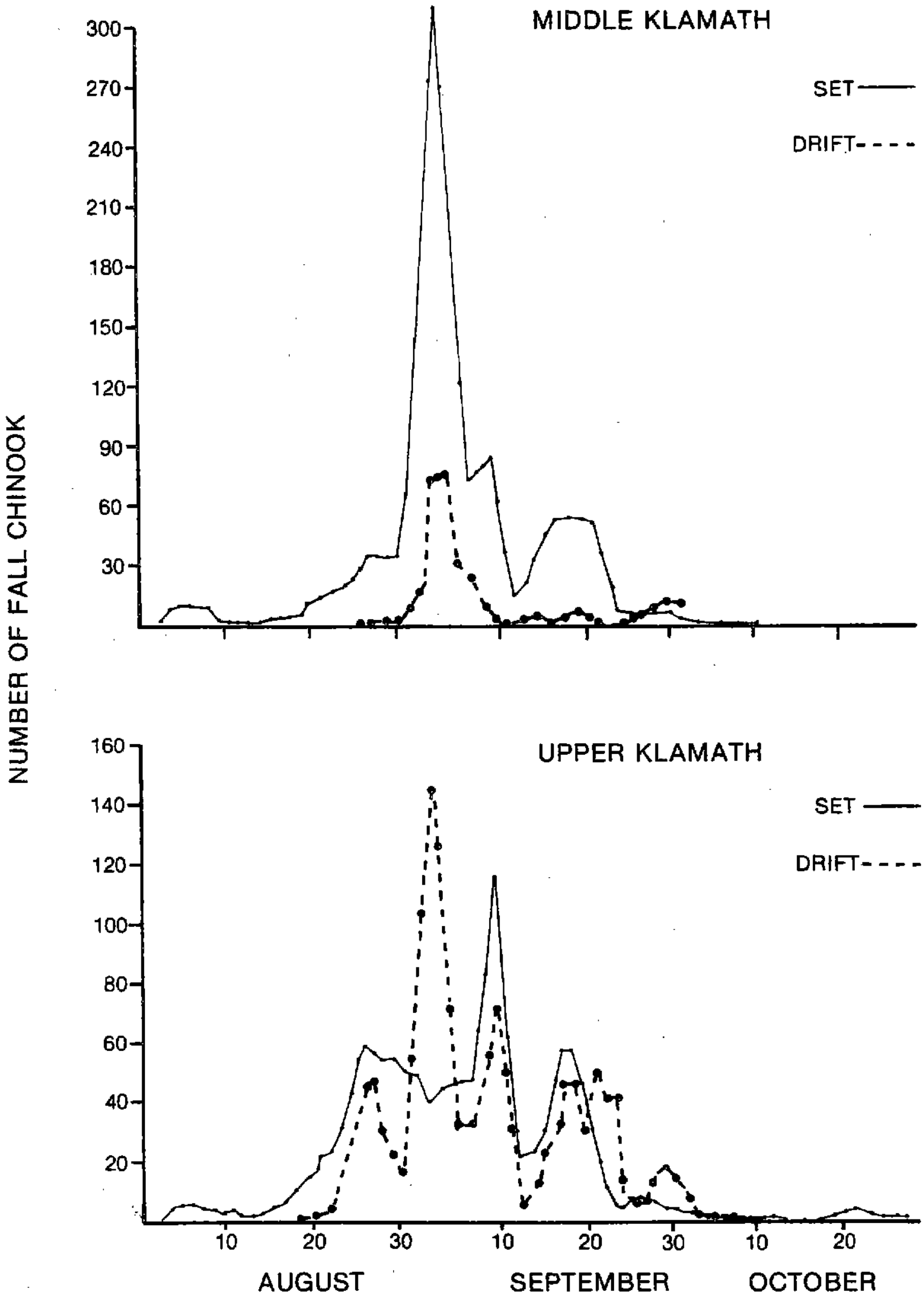


FIGURE 26. Three-day moving averages of the estimated numbers of fall chinook salmon caught by Indian fishers in the Middle and Upper Klamath Areas of the Klamath River in 1984.

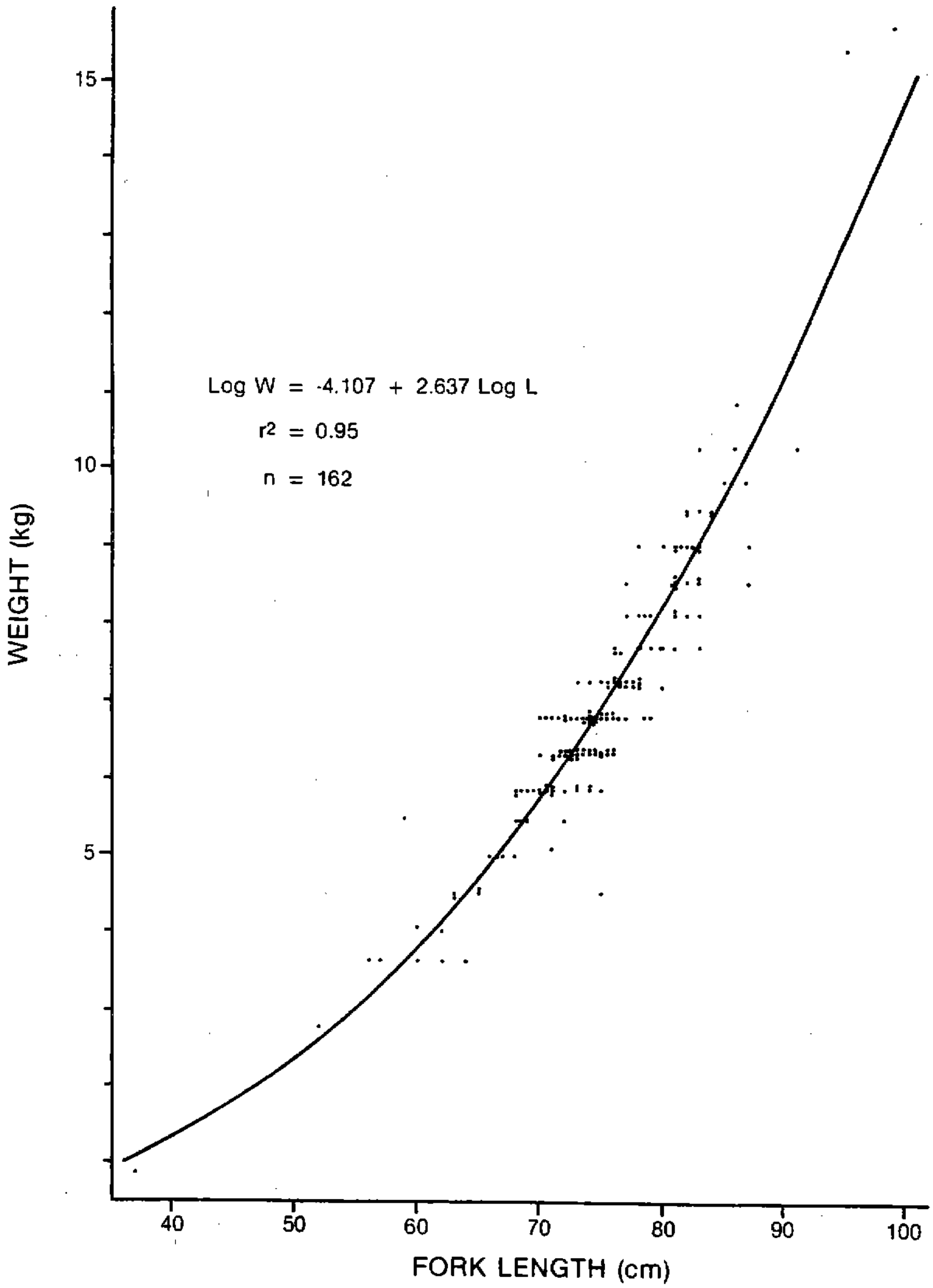


FIGURE 27. Length-weight relationship of fall chinook salmon caught by Indian fishers on the Lower Klamath River in 1984.

averaged 45.3 cm fork length and 1.8 kg in weight, and adults averaged 71.9 cm and 6.2 kg in weight. Combining jack and adult samples, the average fall chinook salmon captured in the Klamath net fishery in 1984 measured 71.2 cm fork length and weighed 6.0 kg.

Based on annual length-weight regressions, fall chinook of a given length had been returning at progressively smaller weight the previous 3 years. This year, however, that trend reversed. A 75 cm chinook would on the average have weighed 6.9 kg in 1984, this is 0.3, 0.8 and 1.3 kg larger than in 1981, 1982 and 1983 respectively.

Length-frequency comparisons of fall chinook harvested in the Estuary Area fishery over the last 4 years (Figure 28), show the 1984 chinook adult mean length, 72.4 cm, to be significantly smaller ($p<0.05$) than the respective mean length of adults in the 1983, 1982 and 1981 Estuary Area, while the mean length of jacks harvested in the Estuary Area (45.7 cm) in 1984 was significantly smaller ($p<0.05$) than in 1981 and 1982, but significantly larger ($p<0.05$) than in 1983.

Length-frequency comparisons of fall chinook harvested in the three Klamath Areas show that mean fork length of adult chinook was not significantly different ($p>0.05$) between the Estuary and Middle Klamath Area (Figure 29). As in the past, the mean fork length of adult chinook taken in the Upper Klamath Area fishery was significantly smaller ($p<0.05$) than those in the Estuary and Middle Klamath fisheries. Jacks displayed no significant differences ($p>0.05$) in mean fork length between the three areas.

Length-frequency distributions of fall chinook taken in the 1981, 1982, 1983 and 1984 total net fisheries of the Klamath River are presented in Figure 30. Mean lengths of adult and jack chinook taken in 1984 were significantly larger ($p<0.05$) than in 1983, but were significantly smaller ($p<0.05$) than in 1981 and 1982.

Chinook exhibiting adipose fin-clips, representing various hatchery CWT release groups, comprised 5.2% of the total 1984 fall chinook net harvest in the Klamath River portion of the reservation, including 5.4, 4.9, and 5.2% of the harvest in the Estuary, Middle Klamath and Upper Klamath Areas, respectively (Table 18). Adipose-clipped adult chinook averaged 71.1 cm fork length and were not significantly different ($p>0.05$) than non-clipped adult chinook harvested in the 1984 Klamath River net fishery.

Right and left ventral (RV and LV) fin-clipped fall chinook, representing a constant fractional marking program for Iron Gate (IGH) and Trinity River (TRH) hatcheries, entered the net fishery as 2-, 3-, 4- and 5-year-olds in 1984. Totals of 169 LV (IGH) and 49 RV (TRH) clipped chinook were sampled in the 1984 Klamath River net harvest, with 43.6, 22.5 and 33.9% of the ventrally-clipped fish observed in the Estuary, Middle Klamath and Upper Klamath Areas, respectively. As in 1983, RV-clipped adult chinook sampled in the net fishery were significantly smaller ($p<0.05$) than LV-clipped and non-clipped adults (Figure 31). LV-clipped adult chinook were not significantly different ($p>0.05$) in fork length from the non-clipped adult chinook. As seen in previous years, LV-clipped fish were observed earlier in the net fishery than the RV-clipped fish. In the Estuary Area, where the majority of fin-clipped fish were seen, the occurrence of LV-clipped fish peaked the week

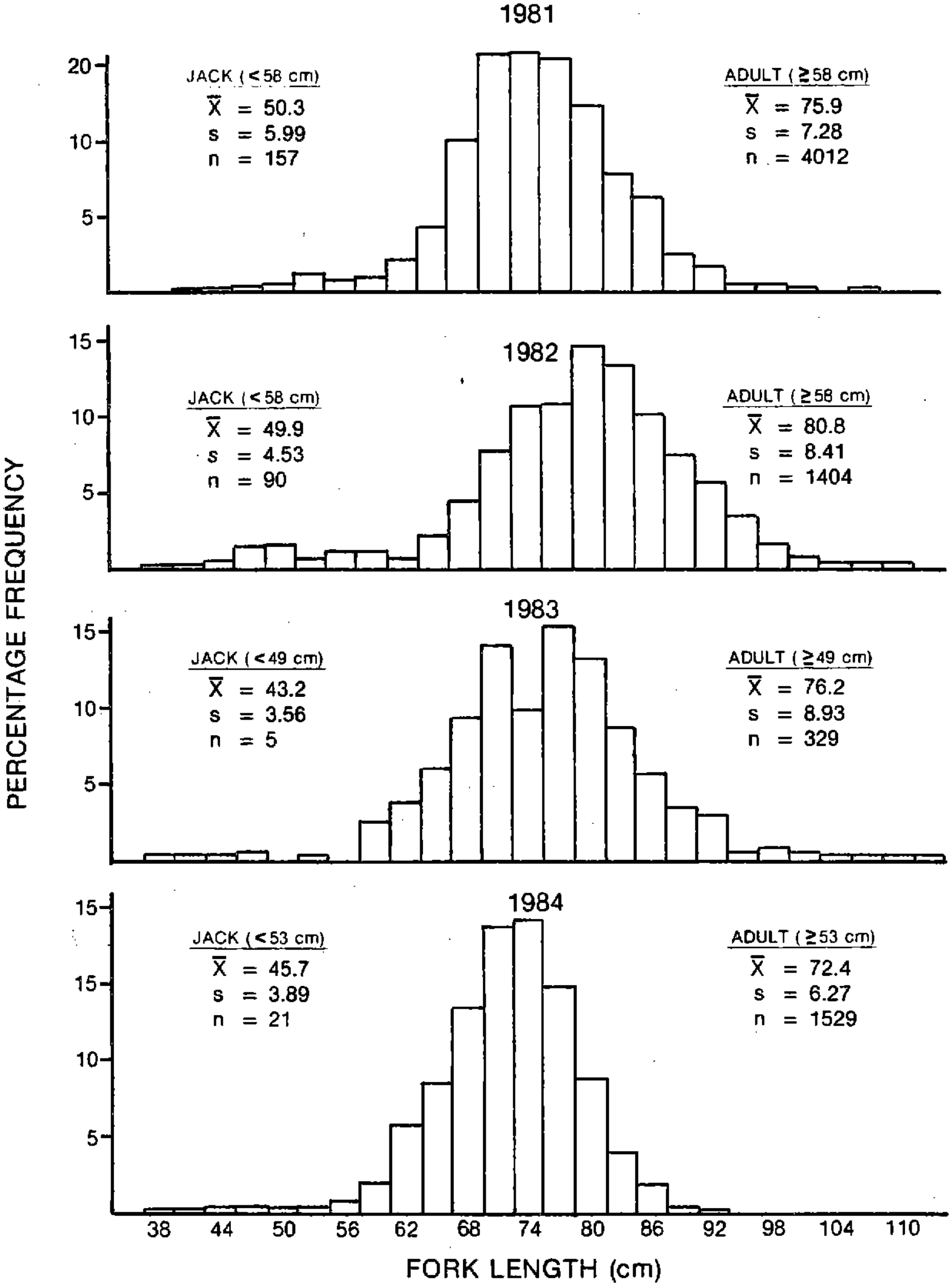


FIGURE 28. Length frequency distributions of fall chinook salmon caught by Indian gill net fishers in the Estuary Area during 1981-1984 (3 cm groupings with midpoints noted).

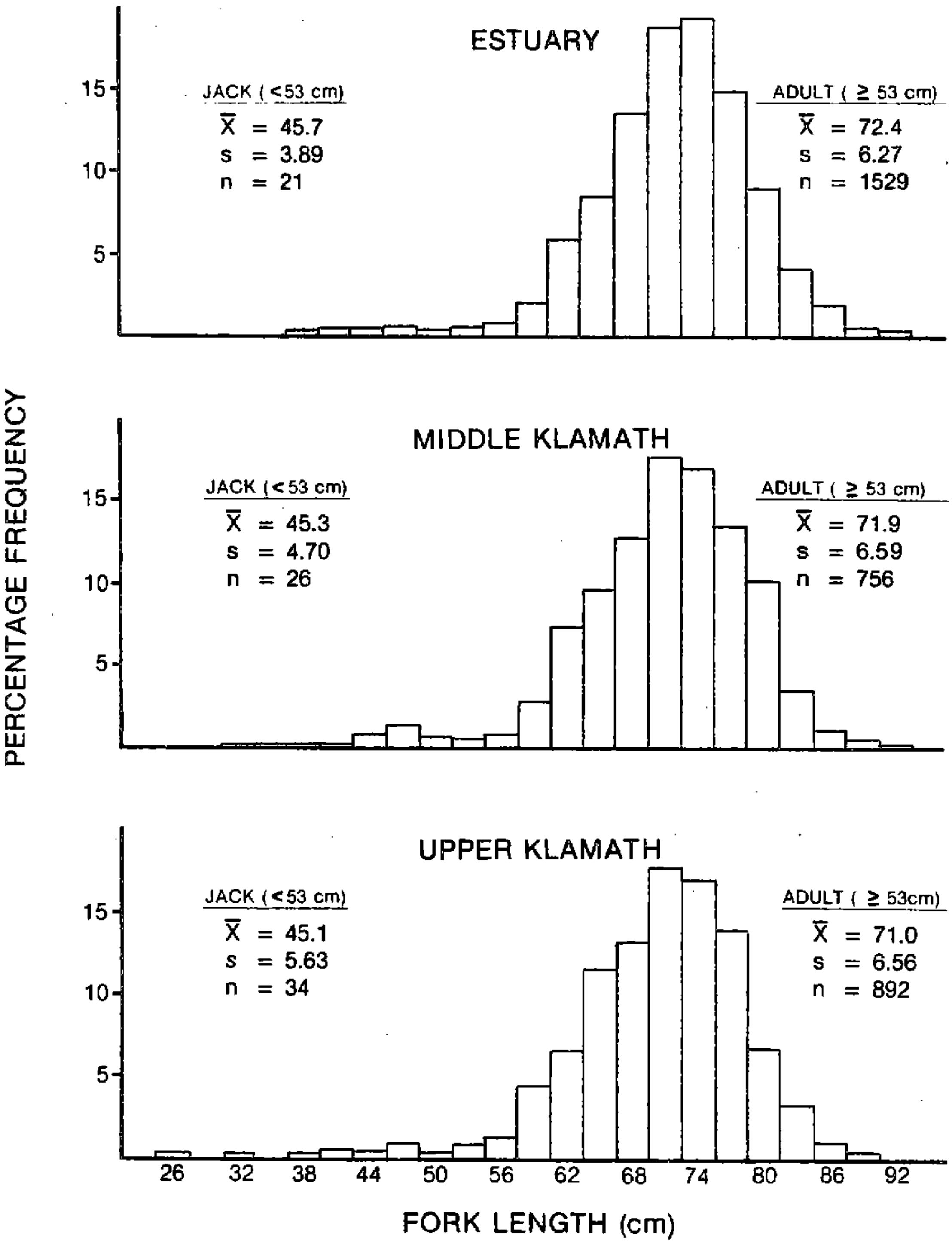


FIGURE 29. Length frequency distributions of fall chinook salmon caught by Indian gill net fishers in the Estuary, Middle Klamath, and Upper Klamath Areas in 1984 (3 cm groupings with midpoints noted).

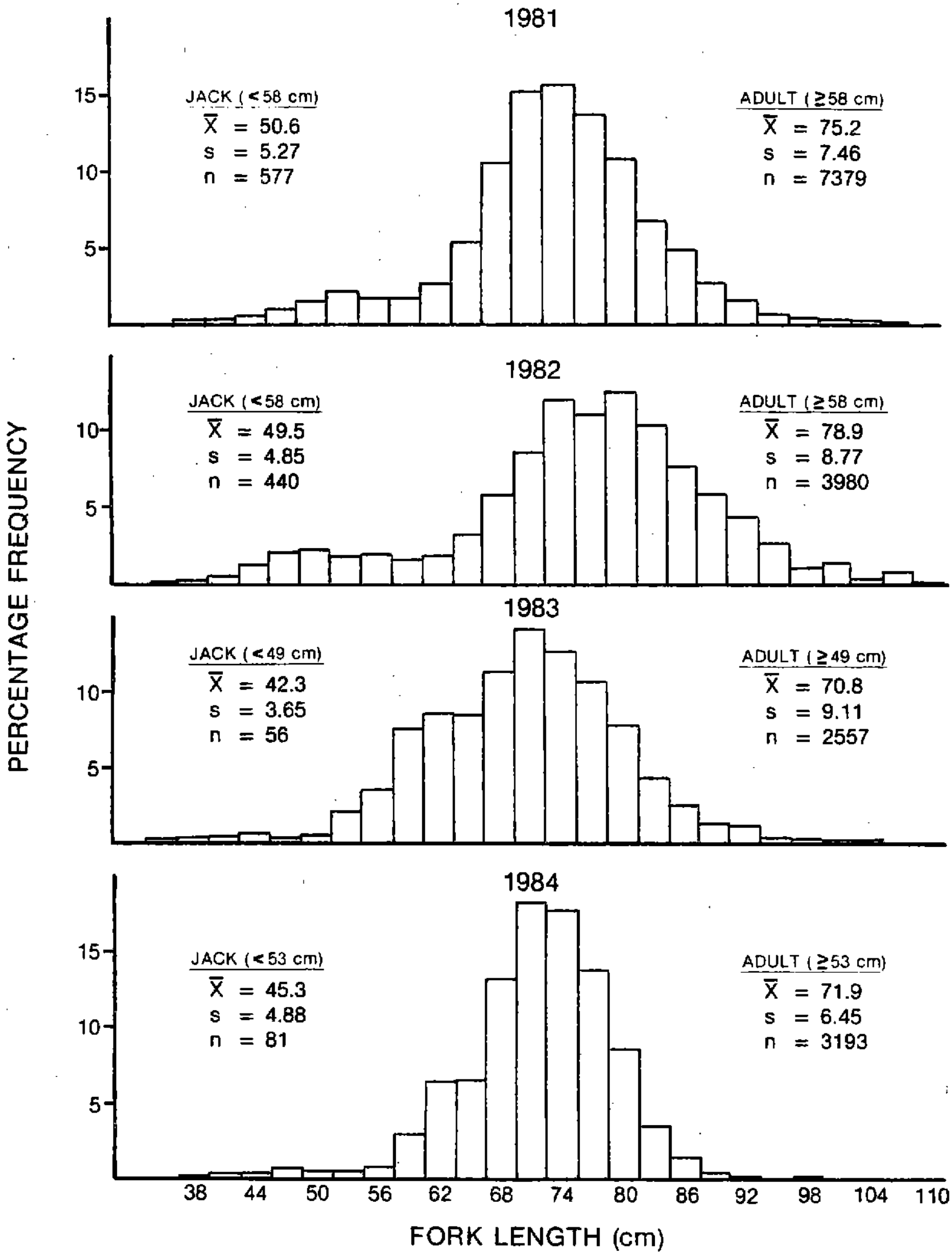


FIGURE 30. Length frequency distributions of fall chinook salmon caught by Indian gill net fishers on the Klamath River portion of the Hoopa Valley Reservation during 1981-1984 (3 cm groupings with midpoints noted).

TABLE 18. Number of fin-clipped fall chinook salmon observed in the 1984 Indian gill net fishery on the Klamath River portion of the Hoopa Valley Reservation.

		FIN CLIPS					
		AD		LV		RV	
Area	Mark Sample	N	%	N	%	N	%
Estuary	1,866	102	5.4	91	4.3	14	.7
Middle Klamath	920	45	4.9	35	3.8	14	1.5
Upper Klamath	937	49	5.2	53	5.7	21	2.2
Total	3,723	196	5.3	169	4.5	49	1.3

TABLE 19. Incidences of seal and otter depredation observed on fall chinook salmon captured in the 1984 gill net fisheries on the Klamath River portion of the Hoopa Valley Reservation.

		SEAL BITES		OTTER BITES	
Area	Sample Size	Number Bitten	Percent Bitten	Number Bitten	Percent Bitten
Estuary	1,585	116	7.3	0	0.0
Middle Klamath	815	8	1.0	30	3.7
Upper Klamath	954	5	.5	41	4.3
Total	3,354	129	3.8	71	2.1

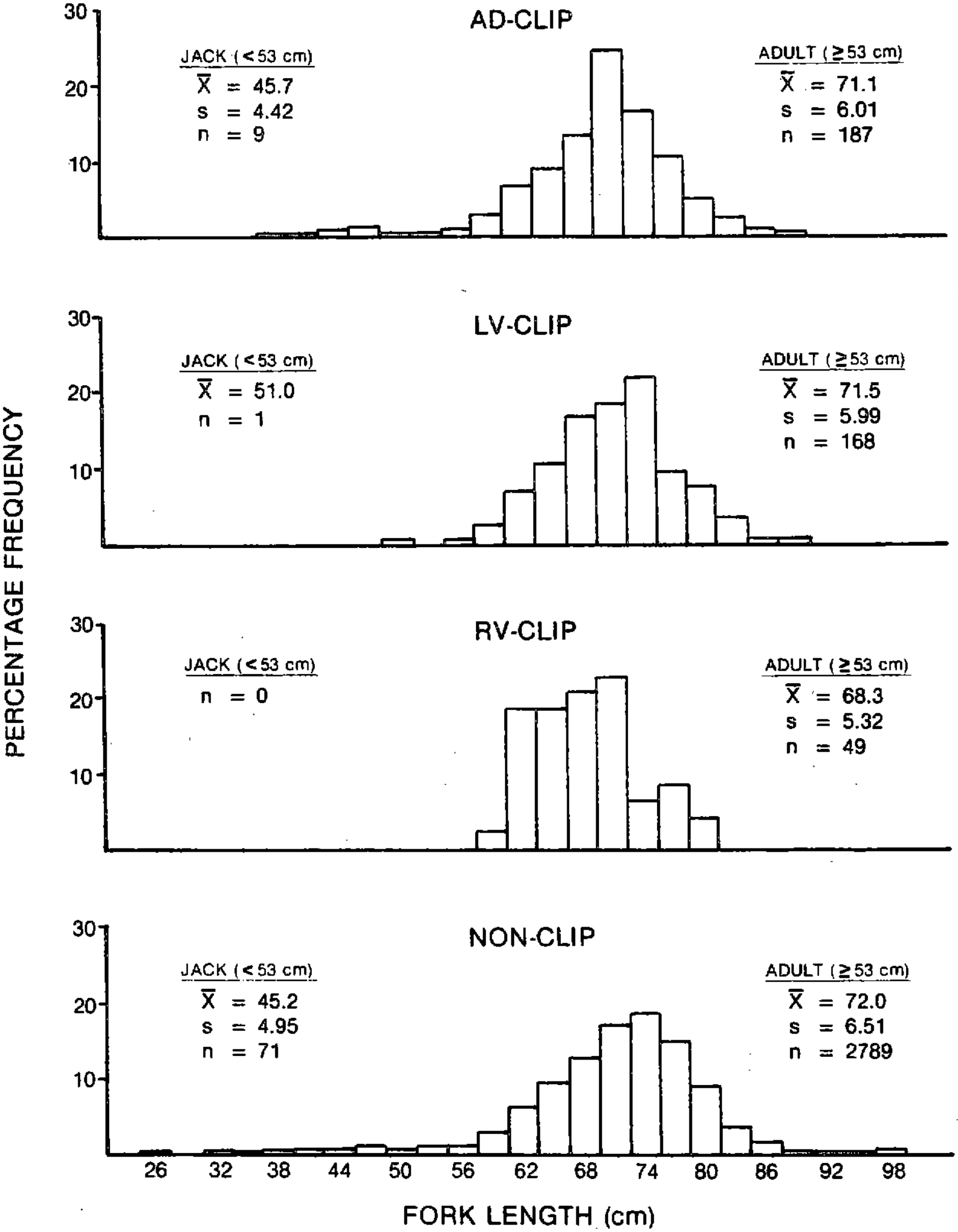


FIGURE 31. Length frequency distributions of adipose-clipped (AD-CLIP), left ventral-clipped (LV-CLIP), right ventral-clipped (RV-CLIP), and non-clipped (NON-CLIP) chinook salmon caught by Indian gill net fishers on the Klamath River portion of the Hoopa Valley Reservation in 1984 (3 cm groupings with midpoints noted).

of August 21 to August 27 while the RV-clipped fish peaked the week of September 3 to September 10 (Figure 32). This trend was also observed upriver, although there appeared to be more of a mixture of the two marks after August 27.

Seal and otter depredation on chinook salmon taken in the Klamath River net fisheries continue to be a problem. In the Estuary Area 7.3% the sampled fall chinook harvest was observed with seal Phoca vitulina or sealion (Zalophus californianus and Eumetopias jubatus) bites (Table 19). This is about half the percentage observed in 1983 but higher than 1981 when 5.3% of the sampled fall chinook exhibited bites. No comparable data were collected for 1982. Seal bites were also observed in the upper river areas, but these could have occurred while the fish were in the lower river. It should be noted that depredation percentages presented here represent minimum values, since they do not take into account fish removed from nets by predators or severely damaged fish discarded and not reported by Indian fishers.

In the Middle and Upper Klamath Areas, 3.7% and 4.3% of the sampled fall chinook salmon netted exhibited bite marks, apparently from river otter Lutra canadensis. These percentages should also be considered minimums. Netted fish were also reported being removed and eaten by black bear Ursus americanus.

Spring Chinook

FAO-Arcata biologists examined 22 spring chinook salmon on the Klamath River in 1984. Based on 998 contacts with Indian fishers, net harvest on the Klamath River portion of the HVR was estimated at 259 spring chinook salmon, including 247 adults and 12 jacks (<52 cm). Harvest of spring chinook began in April and continued through July with the majority of the catch occurring in May. The Middle Klamath Area fishery accounted for 61.8% of the Klamath River harvest, followed by the Estuary (21.2%) and the Upper Klamath Area (17.0%) fisheries, respectively (Table 20). The mean length of adult spring chinook harvested in the net fishery in 1984 was not significantly different ($p>0.05$) from that of fish taken in 1981-1983 (Figure 33).

In 1984, adipose fin-clipped salmon comprised 18.2% of the total Klamath River spring chinook salmon harvest sample. This percentage was considerably lower than in 1983 when 51.4% of the sampled spring chinook harvest was adipose fin-clipped. This decrease in ad-clipped fish observed can be attributable to the combination of the small number of 1980 brood spring chinook released from Trinity River Hatchery, which would have returned as 4-year-olds this spring.

Table 21 summarizes spring and fall chinook harvest estimates for the years 1977-1984.

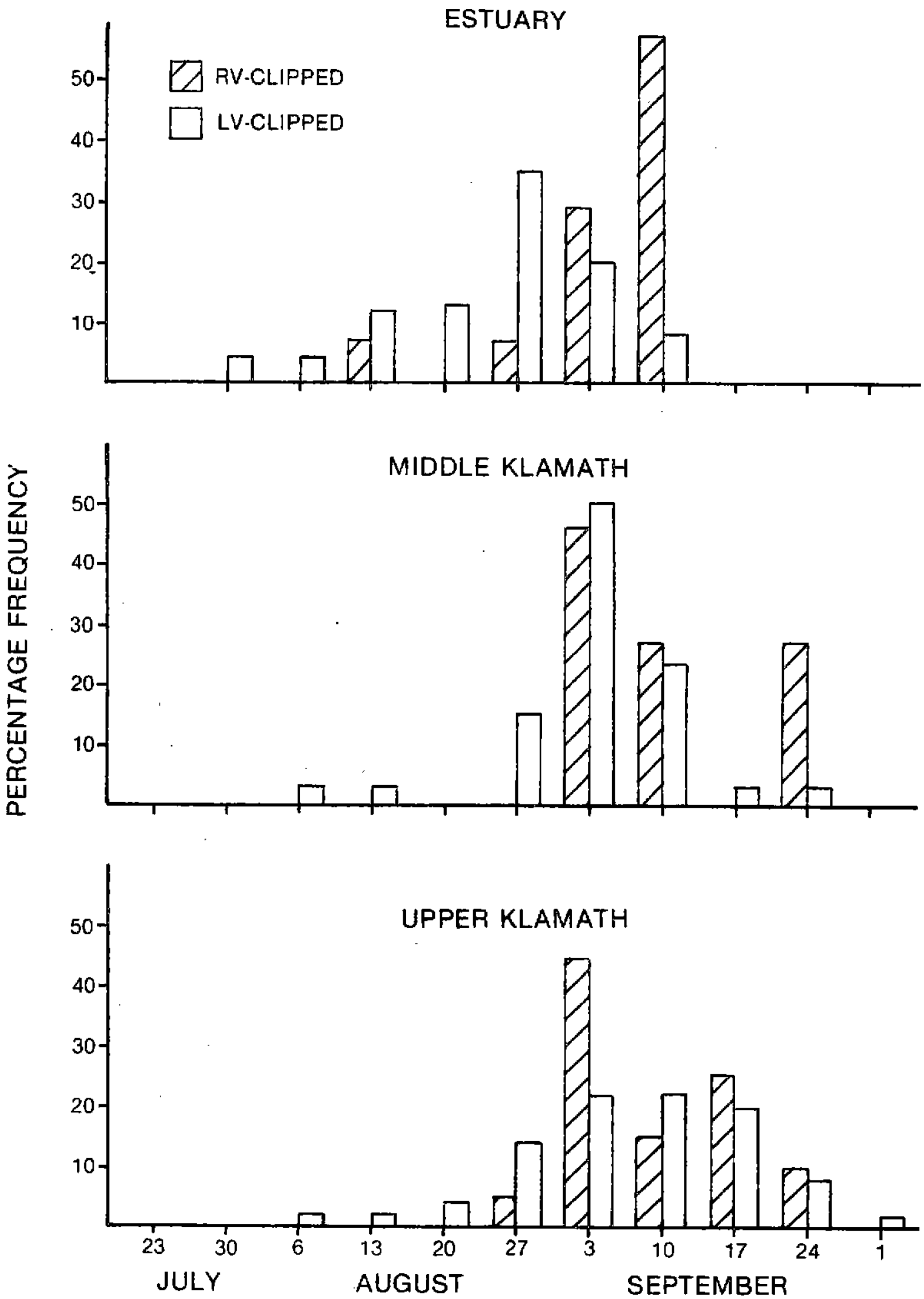


FIGURE 32. Percentage occurrence of LV- and RV-clipped fall chinook salmon by week during the 1984 net fishery in the Estuary, Middle Klamath, and Upper Klamath Areas.

TABLE 20. Monthly net harvest estimates of spring chinook salmon captured in the three Klamath River monitoring areas of the Hoopa Valley Reservation in 1984.

Month	NET HARVEST MONITORING AREA Estuary	Middle Klamath	Upper Klamath	Cumulative Monthly Total (All Areas)	Seasonal Total
April	1	20	4	25	25
May	3	90	25	118	143
June	1	35	10	46	189
July	50	15	5	70	259
Total Percentage	55	160	44	259	

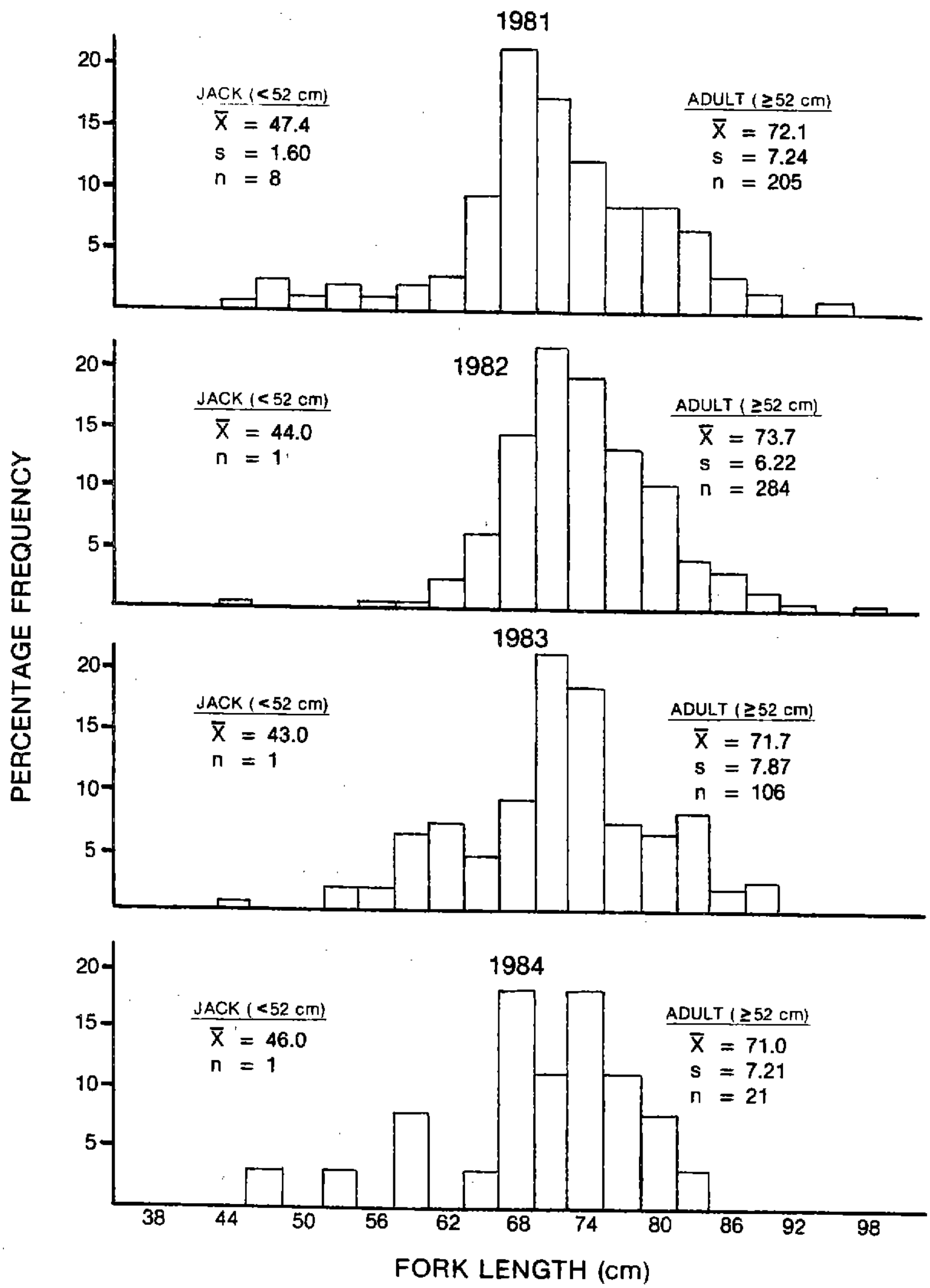


FIGURE 33. Length frequency distributions of spring chinook salmon caught by Indian gill net fishers on the Klamath River portion of the Hoopa Valley Reservation during 1981-1984 (3 cm groupings with midpoints noted).

TABLE 21. Final harvest estimates of spring and fall chinook salmon taken in the net fishery on the Hoopa Valley Reservation during 1977-1984 1/.

Year	SPRING CHINOOK Jacks	SPRING CHINOOK Adults	SPRING CHINOOK Total	FALL CHINOOK Jacks	FALL CHINOOK Adults	FALL CHINOOK Total
1977	--	--	--	2,700	27,300	30,000 2/
1978	--	--	--	1,800	18,200	20,000 3/
1979	--	--	--	1,350	13,650	15,000 4/
1980	20	980	1,000 5/	987	12,013	13,000 6/
1981	57	2,807	2,864 7/	2,465	33,033	35,498 7/
1982	45	3,155	3,200 8/	1,799	14,482	16,281 8/
1983	10	585	595 9/	163	7,890	8,053 9/
1984	12	627	639 10/	455	18,670	19,125 10/

1/ Estimates for 1983 and 1984 Trinity net fishery were obtained from Hoopa Valley Business Council, Fisheries Department.

2/ From the 1980 Annual Report. No direct monitoring of the catch. Based upon commercial sales receipts and assuming additional subsistence harvest. Jack contribution was derived from a weighted average of the percentage of jack contribution in 1980 and 1981 to the total harvest by monitoring area.

3/ From 1980 Annual Report. Revised downward from 25,000 previously estimated. Based upon harvest monitoring activities through August 28, 1978, and on speculative information throughout remainder of season. Jack contribution derived in same way as 1977 estimates.

4/ From 1980 Annual Report. Revised downward from 20,000 previously estimated. Based on aerial net counts and catch per net night values derived from contacts with a number of Indian fishers. Jack contribution derived in same way as 1977 and 1978.

5/ From 1980 Annual Report. Jack contribution was derived from a weighted average of the percentage of jack contribution in 1981 and 1982 to the total harvest by monitoring area.

6/ Estimation methods described in 1980 Annual Report.

7/ Estimation methods described in 1981 Annual Report.

8/ Estimation methods described in 1982 Annual Report.

9/ Estimation methods described in 1983 Annual Report.

10/ Estimation methods described in 1984 Annual Report.

CODED-WIRE TAG RECOVERY INVESTIGATIONS

INTRODUCTION

Two hatcheries operated by the California Department of Fish and Game (CDFG) are located in the Klamath River basin. Trinity River Hatchery (TRH), at the base of Lewiston Dam, lies 249 river kilometers from the mouth of the Klamath River. Located near the base of Iron Gate Dam on the Klamath River, Iron Gate Hatchery (IGH) lies 306 river kilometers from the mouth. In recent years, these hatcheries have released on-site (at the hatchery) three basic groups of coded-wire tagged (CWT) juvenile chinook salmon; fingerlings in June, yearlings in October, and yearling-plus in March. Trinity River Hatchery also trucked CWT fingerlings downriver to release at off-site (away from the hatchery) locations. Fingerlings from IGH were distributed to an Indian ponding program to grow to the yearling stage for release into upper Klamath River tributaries. The ponding program is a cooperative rearing project between CDFG and the Karok Indian Tribe to provide additional rearing capacities above hatchery levels and increase spawner returns to the tributaries where the rearing ponds are located. Additionally, the Hoopa Valley Business Council (HVBC) operates a rearing facility at Supply Creek near Hoopa on the Trinity River, 90 river kilometers from the mouth of the Klamath River. The first adult fall chinook CWT returns from this facility occurred in 1984.

Since these release programs differ as to site, time and size of release, differing environmental conditions between release and maturity result in varying biological characteristics between release groups upon return. These variations between groups must be analyzed in order to evaluate the effectiveness of the hatchery release programs and the impacts of fisheries operating on the stocks. Toward this end, FAO biologists conducted CWT recovery efforts in conjunction with 1984 net harvest monitoring activities on the Indian gill net fishery on the Klamath River portion of the Hoopa Valley Reservation.

METHODS

Methods of acquiring CWT samples during net harvest monitoring field activities were previously described in this report. Coded-wire tags from the field samples were recovered from salmon heads by dissection utilizing a magnetic field detector and read with the aid of an American Optical 507 dissecting microscope. If no tag was detected, the head was dissolved in Potassium Hydroxide (KOH) for 48 hours. A magnet was then stirred through the resultant slurry to recover tags which did not activate the magnetic field detector. Recovery data for each CWT group were expanded to estimate contribution to the net harvest by time and area employing a procedure similar to that used by Oregon Department of Fish and Wildlife (ODFW) in estimating contributions of CWT to the Oregon ocean troll fishery. The expansion adjusts for the portion of the harvest not sampled, the non-recovery of heads from observed adipose fin-clipped fish and tags lost during dissection:

$$\text{(1) Harvest Sampling Rate} = \frac{\text{Total Estimated Net Harvest}}{\text{Number of Fish Examined for Marks}}$$

$$\text{(2) Head Recovery Rate} = \frac{\text{Number of Ad-clipped Fish Observed}}{\text{Number of Heads Recovered}}$$

$$\text{(3) Lost Tag Rate} = \frac{\text{Number of Heads with Tags}}{\text{Tags Decoded}}$$

The three derived rates were multiplied to yield an expanded tag factor for each CWT group by area and time. The recovery data were then multiplied by the respective expanded tag factors to produce the estimated harvest of each CWT group. Harvest estimates of CWT groups were generally derived monthly (April-June) or semi-monthly (July-October) by area, except when low sampling rates or abbreviated sampling schedules called for deviations from these time periods. Coded-wire tag codes originating from outside the river basin were expanded at a rate of 1:1. The number of heads dissected from which tags were not recovered were expanded using a no-tag expansion factor. The no-tag expansion factor is the product of (1) Harvest Sampling Rate and (2) Head Recovery Rate.

Contribution rates of CWT groups to the Indian net fishery were calculated for each tag code:

$$\text{(4) Contribution Rate (\%)} = \frac{\text{Estimated CWT Harvest}}{\text{Number of Tagged Fish Released}} \times 100$$

The contribution rate compensates for unequal release-size bias and allows comparison between release strategies. Age composition was determined by summing individual CWT group contribution rates and then calculating the percentage contribution of groups in each age class.

RESULTS AND DISCUSSION

Fall Chinook Salmon

Coded-wire tag recoveries from fall chinook in the 1984 Indian net harvest totalled 83, all of which were obtained through the net harvest mark-sampling program (Table 22). The mark-sampled recoveries expanded to an estimated harvest of 702 fall chinook representing 17 release groups: 6 from the Trinity River Hatchery, 5 from Iron Gate Hatchery, 5 from the Karok Indian ponding program and 1 from the Hoopa Valley Business Council rearing facility. Additionally, an estimated 279 ad-clipped fall chinook were harvested that did not contain tags and could not be assigned to a rearing origin.

TABLE 22. Actual and expanded (underlined) CWT groups recovered during mark sampling of fall chinook salmon in the 1984 gill net fishery on the Klamath River portion of the Hoopa Valley Reservation.

Tag Code	Brood Year	Hatchery[1/] of Origin	Release[2/] Type	RESERVATION MONITORING AREA Estuary		Middle Klamath		Upper Klamath		All Areas	
06-50-11	1982	IGH	Y	0	0	1	2	0	0	1	2
06-52-01	1981	TRH	F[3/]	1	18	4	49	1	5	6	72
06-59-05	1980	IGH	F	6	42	0	0	1	5	7	47
06-59-06	1980	IGH	Y	20	180	5	42	6	32	31	254
06-59-07	1981	IGH	F	6	82	9	61	2	11	17	154
06-59-09	1982	IGH	F	1	18	0	0	0	0	1	18
06-59-12	1980	IGH	F[4/]	0	0	0	0	1	6	1	6
06-59-13	1980	IGH	Y[5/]	1	12	0	0	1	5	2	17
06-59-14	1980	IGH	Y[6/]	2	25	0	0	3	19	5	44
06-59-16	1980	IGH	F[7/]	1	3	0	0	0	0	1	3
06-59-17	1980	IGH	Y[8/]	1	3	0	0	0	0	1	3
06-61-17	1979	TRH	F[9/]	1	4	0	0	0	0	1	4
06-61-20	1979	TRH	Y+	0	0	0	0	1	5	1	5
06-61-21	1980	TRH	Y	2	25	1	2	2	10	5	37
06-61-22	1981	TRH	Y	1	18	0	0	0	0	1	18
06-61-25	1982	TRH	F[10/]	0	0	1	12	0	0	1	12
06-61-29	1982	TRH	Y	0	0	0	0	1	6	1	6
TOTAL TAGS				43	430	21	168	19	104	83	702
AD - NO TAGS				16	207	4	19	10	53	30	279

1/ IGH - Iron Gate Hatchery
TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to November release
Y+ (Yearling-Plus) - March release

3/ Reared at Hoopa Valley Business Council Hatchery, released at Supply Creek (Trinity)

4/ Accidental fingerling release - Beaver Creek Ponding Program (Klamath)

5/ Thompson Creek Ponding Program (Klamath)

6/ Redcap Creek Ponding Program (Klamath)

7/ Accidental fingerling release - Indian Creek Ponding Program (Klamath)

8/ Redcap and Camp Creek Ponding Program (Klamath)

9/ Off-site release at Trinity River kilometer 40.0 (Willow Creek)

10/ Off-site release at Trinity River kilometer 198.0 (Junction City)

The CWT expansion methodology employed during 1984 has been changed from previous years. In the past, all ad-clipped salmon in the sample were assigned to a tag group regardless of whether or not a tag could be recovered by dissection. As long as all tag groups treated in this fashion had near equal tag shedding rates, this treatment was valid. However, the assumption of near equal tag loss rates was found to be invalid. In 1984, 26.1% of the recovered heads did not contain CWT. In 1983, 23.4% of the recovered heads did not contain CWT while in 1982 the no-tag rate was 11.5%. This increase in non-recovery of tags since 1982, under close examination, has not occurred proportionally between CWT release groups within the basin. In order to correct for this bias and to bring FAO-Arcata CWT data more in line with that presented by the CDFG and ODFW during recent years, CWT harvests in the HVR net fishery were recalculated for 1982 and 1983 fall chinook as described for 1984 (Tables 23 and 24). This change in methodology and expansion calculations will now provide data more comparable to CDFG and ODFW recovery data.

Contribution rates of fall chinook from TRH CWT release groups to the 1982 -1984 Indian net fishery varied with the type and site of release (Table 25). Juveniles released at a larger size contributed to the net fishery at a higher rate. For on-site hatchery releases, the highest average contribution rate occurred among the yearling-plus groups (0.174%), followed by yearling (0.075%) and fingerling (0.005%) groups. Release site comparisons show fingerlings planted off-site (0.098%) contributed almost 20 times the rate of on-site releases (0.005%). The lack of returns from the tag code (06-61-18), 1980 brood year TRH fingerling should be noted. In 1982 an estimated 16 jacks from tag code (06-61-18) were caught in the Indian net fishery; however, no 3- or 4-year-olds were caught in either 1983 or 1984. Although the CDFG has noted no special disease or mortality problems with this release, returns to the hatchery from this tag code have been minimal. Another TRH fingerling release from the 1981 brood year (06-61-19) has also shown poor returns so far, but because the 4-year-old adult component is not due to return until 1985, a complete analysis of contribution is not possible at this time.

Fall chinook contribution rates from IGH CWT release groups to the 1982 -1984 Indian net fisheries also varied by release type (Table 25). Age 3- and 4-year-old adult returns showed yearling releases (0.208%) contributed at a higher rate than fingerling releases (0.053%). Of special note however are the IGH 1981 yearling and fingerling releases which returned as 3-year-olds in 1984. The fingerling release (06-59-07) was the second largest contributor of all tags recovered in 1984. Yearling releases (06-59-04, 06-59-18 and 06-59-19) on the other hand did not contribute to the 1984 net fishery. A full evaluation will be made next year when complete 3- and 4-year-old returns become available.

Iron Gate Hatchery, Trinity River Hatchery, Hoopa Valley Business Council and Karok Indian ponding program CWT releases contributed at varying rates to the 1984 Klamath River Indian net fishery. Combined contribution rates of age 3 (1981 Brood Year) and age 4 (1980 Brood Year) CWT fall chinook harvested in 1984 were compared. The IGH fall chinook (0.097%) contributed at the highest rate followed by the ponding program (0.074%), HVBC (0.038%) and TRH (0.013%). Comparing the major hatcheries, IGH contributed at over 7 times the rate of TRH. This number represents a minimum since IGH fish exhibited CWT shedding rates considerably greater than fish tagged at TRH.

TABLE 23. Actual and expanded (underlined) CWT groups recovered during mark-sampling of fall chinook salmon in the 1982 gill net fishery on the Hoopa Valley Reservation.

Tag Code	Brood Year	Hatchery 1/ of Origin	Release 2/ Type	RESERVATION MONITORING AREA Estuary		Middle Klamath 3/		Upper Klamath 4/		Trinity		All Areas	
06-59-01	1978	IGH	Y	48	156	30	73	45	209	0	0	123	438
06-59-02	1979	IGH	Y	4	14	2	4	1	5	1	3	8	26
06-59-03	1979	IGH	F	6	22	7	16	8	43	0	0	21	81
06-59-05	1980	IGH	F	1	2	1	2	1	5	0	0	3	9
06-59-16	1980	IGH	F 5/	0	0	1	3	1	5	0	0	2	8
06-61-02	1977	TRH	F	0	0	0	0	1	8	0	0	1	8
06-61-08	1978	TRH	F	0	0	0	0	0	0	4	11	4	11
06-61-09	1979	TRH	Y	2	8	2	5	4	22	5	14	13	49
06-61-10	1978	TRH	F 6/	2	8	0	0	1	11	2	6	5	25
06-61-14	1978	TRH	Y	9	34	7	18	4	19	7	19	27	90
06-61-15	1978	TRH	Y+	14	54	13	31	10	52	16	47	53	184
06-61-16	1979	TRH	F	0	0	0	0	1	5	3	9	4	14
06-61-17	1979	TRH	F 7/	4	10	4	11	8	38	25	82	41	141
06-61-18	1980	TRH	F	0	0	0	0	1	5	2	11	3	16
06-61-20	1979	TRH	Y+	2	4	4	10	9	48	14	43	29	105
06-61-21	1980	TRH	Y	0	0	2	5	3	16	4	12	9	33
07-18-53	1978	CRH	Y	1	1	0	0	0	0	0	0	1	1
TOTAL TAGS				93	313	73	178	98	491	83	257	347	1239
AD - NO TAGS				24	84	25	61	13	63	13	39	75	247

1/ CRH - Cole Rivers Hatchery (Rogue River system)
TRH - Trinity River Hatchery
IGH - Iron Gate Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to November release
Y+ (Yearling-Plus) - March release

3/ Middle Klamath A Section - Highway 101 Bridge to Terwer Creek

4/ Combined Middle Klamath B Section and Upper Klamath Area - Terwer Creek to the Trinity River

5/ Indian Creek Ponding Program off-site release

6/ Off-site release at Trinity River kilometer 20.0

7/ Off-site release at Trinity River kilometer 40.0 (Willow Creek)

TABLE 24. Actual and expanded (underlined) CWT groups recovered during mark sampling of fall chinook salmon in the 1983 gill net fishery on the Klamath River portion of the Hoopa Valley Reservation.

Tag Code	Brood Year	Hatchery 1/ of Origin	Release 2/ Type	RESERVATION MONITORING AREA Estuary		Middle Klamath		Upper Klamath		All Areas	
06-59-01	1978	IGH	Y	1	4	1	4	2	5	4	13
06-59-02	1979	IGH	Y	1	2	3	30	10	27	14	59
06-59-03	1979	IGH	F	3	7	0	0	5	14	8	21
06-59-05	1980	IGH	F	2	6	2	17	10	27	14	50
06-59-06	1980	IGH	Y	0	0	2	17	4	11	6	28
06-59-12	1980	IGH	F 3/	1	2	0	0	0	0	1	2
06-59-13	1980	IGH	Y 4/	0	0	0	0	2	5	2	5
06-59-14	1980	IGH	Y 5/	0	0	0	0	5	13	5	13
06-59-15	1980	IGH	F 6/	0	0	0	0	1	3	1	3
06-59-16	1980	IGH	F 6/	0	0	0	0	2	5	2	5
06-59-17	1980	IGH	Y 7/	0	0	1	4	2	5	3	9
06-61-09	1979	TRH	Y	0	0	2	17	6	15	8	32
06-61-15	1978	TRH	Y+	0	0	0	0	1	3	1	3
06-61-16	1979	TRH	F	0	0	0	0	1	5	1	5
06-61-17	1979	TRH	F 8/	1	4	6	22	8	23	15	49
06-61-20	1979	TRH	Y+	1	4	2	6	11	29	14	39
06-61-21	1980	TRH	Y	0	0	1	4	8	21	9	25
TOTAL TAGS				10	29	20	121	78	211	108	361
AD - NO TAGS				5	12	7	37	22	59	34	108

1/ IGH - Iron Gate Hatchery
TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to November release
Y+ (Yearling-Plus) - March release

3/ Accidental fingerling release - Beaver Creek Ponding Program (Klamath)

4/ Thompson Creek Ponding Program (Klamath)

5/ Redcap Creek Ponding Program (Klamath)

6/ Accidental fingerling release - Indian Creek Ponding Program (Klamath)

7/ Redcap and Camp Creek Ponding Program (Klamath)

8/ Off-site release at Trinity River kilometer 40 (Willow Creek)

TABLE 25. Contribution rate of CWT age 3 and 4 fall chinook to the Indian net fishery on the Klamath River portion of the Hoopa Valley Reservation.

Tag Code	Brood Year	Rearing 1/ Facility	Release 2/ Type	NUMBER HARVESTED 3/ 3	4	Total	Number 4/ Released Tagged	Contribution 5/ Rate
06-61-16	1979	TRH	F	14	5	19	188,727	.010
06-61-17	1979	TRH	F 6/	141	49	190	193,897	.098
06-61-09	1979	TRH	Y	49	32	81	90,995	.089
06-61-20	1979	TRH	Y+	105	39	144	82,982	.174
06-59-02	1979	IGH	Y	26	59	85	91,000	.093
06-59-03	1979	IGH	F	81	21	102	189,420	.054
06-61-18	1980	TRH	F	0	0	0	201,090	0
06-61-21	1980	TRH	Y	25	37	62	104,160	.060
06-59-06	1980	IGH	Y	28	254	282	87,450	.322
06-59-05	1980	IGH	F	50	47	97	185,857	.052
06-61-19	1980	TRH	F	0	-	0	192,795	0
06-61-22	1981	TRH	Y	18	-	18	94,991	.019
06-59-07	1981	IGH	F	154	-	154	159,092	.097
06-59-04	1981	IGH	Y	0	-	0	65,385	0
06-59-18	1981	IGH	Y	0	-	0	25,586	0
06-59-19	1981	IGH	Y	0	-	0	30,781	0
06-52-01	1981	HVBC	F	72	-	72	34,000	.212

1/ IGH - Iron Gate Hatchery
TRH - Trinity River Hatchery
HVBC - Hoopa Valley Business Council Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to November release
Y+ (Yearling-Plus) - March release

3/ Estimated number of coded-wire tagged fall chinook

4/ From Pacific Marine Fisheries Commission CWT release data

5/ Contribution rate = number harvested / number released tagged X 100

6/ Off-site release at Trinity River kilometer 40.0 (Willow Creek)

The age composition of CWT fall chinook salmon harvested in the 1984 Indian net fishery was 0.6% 5-year-olds, 64.0% 4-year-olds, 27.9% 3-year-olds and 6.6% 2-year-olds. Age composition of CWT fall chinook in the net catch shifted from mostly 3-year-olds in 1983 to predominately 4-year-olds in 1984.

As in past years, IGH CWT groups entered the net fishery earlier than TRH. In the Estuary Area fishery, 100% of the fish caught during August were of IGH origin. From September 1-15, 72% were from IGH and after September 15, 100% of the CWT chinook originated from TRH.

In past years, CWT groups have shown an inverse relationship between size at release and size at harvest. In 1984, within each age class, the mean length at harvest generally decreased from fingerling to yearling releases (Table 26). However, because of poor returns from three tag codes, only one statistical comparison was possible. The fingerling IGH 4-year-old return, (06-59-05), was 2.2 cm larger than the comparable yearling release (06-59-06), but the difference was not significant ($p>0.05$).

Coded-wire tag recoveries from 4-year-old chinook groups in the net fishery were generally of a similar mean length in 1984 as in 1983 except for one TRH group. Comparisons of IGH 1984 (06-59-06) versus 1983 (06-59-02) yearlings and IGH 1984 (06-59-05) versus 1983 (06-59-03) fingerlings show similar mean lengths. The TRH yearling release (06-61-21) mean length was significantly ($p<0.05$) smaller (4.6 cm) than the comparable 1983 recovery group (06-61-09). Only one 1984 versus 1983 comparison of 3-year-olds was possible: IGH fingerling release (06-59-07) was 2.4 cm longer than the 1983 comparable group (06-59-05), but the difference was not significant ($p>0.05$).

Coded-wire tag groups harvested in 1984 were smaller than comparable releases from years prior to 1983. For the TRH yearling release returning as 4-year-olds (06-61-21), 1984 recoveries were significantly smaller than comparable returns in 1980, 1981 or 1982 ($p<0.05$). The IGH yearling release (06-59-06) returning as 4-year-olds, was significantly ($p<0.05$) smaller than the comparable 1982 recovery group (06-59-01). The IGH fingerling release (06-59-07) returning as 3-year-old adults was significantly ($p<0.05$) smaller than the comparable 1982 recovery group (06-59-03).

Spring Chinook

Coded-wire tag recoveries from spring chinook salmon in the 1984 Indian net harvest in the Klamath River totaled 10, all of which were obtained through the net harvest mark-sample program (Table 27). The mark-sample recoveries expanded to an estimated 49 spring chinook representing three release groups: two from TRH and one from Cole Rivers Hatchery on the Rogue River in Oregon. Although all of the ad-clipped spring chinook recovered for CWT analysis contained CWT's, spring chinook recoveries in 1982 and 1983 had no-tag rates of 12.3% and 28.6% respectively. The 1982 and 1983 expansions were accordingly recalculated using the methodology employed in 1984 (Tables 28 and 29).

Contribution rates of TRH spring chinook CWT release groups to the 1982 -1984 Klamath River Indian net fishery varied with the type and site of release (Table 30). The 1979 brood year was the last time a full complement

TABLE 26. Mean fork length, standard deviation and number of recoveries for 17 fall chinook CWT groups harvested in the Klamath River portion of the Hoopa Valley Reservation in 1984.

Tag Code	Brood Year	Hatchery[1/] of Origin	Release[2/] Type	RESERVATION MONITORING AREA: Estuary	Middle Klamath	Upper Klamath	All Areas
06-61-17	1979	TRH	F[3/]	77.0[4/] ---[5/] 1[6/]	--- --- 0	--- --- 0	77.0 --- 1
06-61-20	1979	TRH	Y+	--- --- 0	--- --- 0	79.0 --- 1	79.0 --- 1
06-59-05	1980	IGH	F	77.7 3.14 6	--- --- 0	71.0 --- 1	76.7 3.82 7
06-59-06	1980	IGH	Y	75.2 5.53 20	74.8 3.70 5	71.7 3.01 6	74.5 4.97 31
06-59-12	1980	IGH	F[3/]	--- --- 0	--- --- 0	72.0 --- 1	72.0 --- 1
06-59-13	1980	IGH	Y[3/]	77.0 --- 1	--- --- 0	69.0 --- 1	73.0 5.66 2
06-59-14	1980	IGH	Y[3/]	73.0 2.83 2	--- --- 0	72.0 5.20 3	72.4 3.97 5
06-59-16	1980	IGH	F[3/]	80.0 --- 1	--- --- 0	--- --- 0	80.0 --- 1
06-59-17	1980	IGH	Y[3/]	76.0 --- 1	--- --- 0	--- --- 0	76.0 --- 1
06-61-21	1980	TRH	Y	70.0 2.83 2	67.0 --- 1	70.0 4.24 2	69.4 2.88 5
06-61-22	1980	TRH	Y	63.0 --- 1	--- --- 0	--- --- 0	63.0 --- 1
06-52-01	1981	TRH	F[3/]	60.0 --- 1	65.3 2.99 4	65.0 --- 1	64.3 3.14 6
06-59-07	1981	IGH	F	69.8 5.19 6	65.6 4.45 9	63.5 4.95 2	66.8 5.05 17
06-50-11	1982	IGH	Y	--- --- 0	55.0 --- 1	--- --- 0	55.0 --- 1
06-59-09	1982	IGH	F	47.0 --- 1	--- --- 0	--- --- 0	47.0 --- 1
06-61-25	1982	TRH	F[3/]	--- --- 0	45.0 --- 1	--- --- 0	45.0 --- 1
06-61-29	1982	TRH	Y	--- --- 0	--- --- 0	44.0 --- 1	44.0 --- 1

1/ TRH - Trinity River Hatchery
IGH - Iron Gate Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to November release
Y+ (Yearling-Plus) - March release

3/ Off-site release

4/ Mean fork length

5/ Standard deviation

6/ Number in sample

TABLE 27. Mean fork length, standard deviation, and actual and expanded (underlined) recoveries for spring chinook CWT groups harvested in the net fishery on the Klamath River portion of the Hoopa Valley Reservation in 1984.

Tag Code	Brood Year	Hatchery[1/] of Origin	Release[2/] Type	CWT Recoveries		Mean Fork Length	Standard Deviation
06-61-37	1981	TRH	Y	2	9	66.5	4.95
06-61-39	1980	TRH	Y	7	39	72.0	1.41
07-25-09	1980	CRH	Y	1	1	71.0	----
TOTALS				10	49		

1/ TRH - Trinity River Hatchery
CRH - Cole Rivers Hatchery (Rogue River System)

2/ F (Fingerling) - - May or June release
Y (Yearling) - - - Late September to early December release
Y+ (Yearling-Plus) - March release

TABLE 28. Actual and expanded (underlined) CWT groups recovered during mark-sampling of spring chinook salmon in the 1982 gill net fishery on the Hoopa Valley Reservation.

Tag Code	Brood Year	Hatchery 1/ of Origin	Release 2/ Type	RESERVATION MONITORING AREA									
				Estuary		Middle Klamath 3/		Upper Klamath 4/		Trinity		All Areas	
06-61-11	1978	TRH	F 5/	1	3	1	9	4	35	4	11	10	58
06-61-12	1978	TRH	F	0	0	0	0	1	11	0	0	1	11
06-61-30	1978	TRH	Y	8	71	19	180	34	290	12	38	73	579
06-61-31	1978	TRH	Y+	2	6	12	131	23	214	16	49	53	400
06-61-32	1979	TRH	F	0	0	0	0	0	0	10	28	10	28
06-61-33	1979	TRH	F 6/	2	6	5	24	2	10	39	120	48	160
06-61-34	1979	TRH	Y	3	8	1	3	3	33	15	40	22	84
06-61-36	1979	TRH	Y+	0	0	0	0	0	0	3	8	3	8
07-18-54	1978	CRH	Y+	0	0	1	1	3	3	1	1	5	5
07-19-32	1978	CRH	Y	0	0	1	1	0	0	0	0	1	1
07-19-35	1978	CRH	Y	1	1	0	0	1	1	0	0	2	2
07-22-36	1979	CRH	Y	0	0	1	1	0	0	0	0	1	1
TOTAL TAGS				17	95	41	350	71	597	100	295	229	1337
AD - NO TAGS				3	32	9	85	12	104	8	21	32	242

1/ CRH - Cole Rivers Hatchery (Rogue River system)
TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to early December release
Y+ (Yearling-Plus) - March release

3/ Middle Klamath A Section - Highway 101 Bridge to Terwer Creek

4/ Combined Middle Klamath B Section and Upper Klamath Area - Terwer Creek to the Trinity River

5/ Off-site release at Trinity River kilometer 20.0

6/ Off-site release at Trinity River kilometer 40.0 (Willow Creek)

TABLE 29. Mean fork length, standard deviation, and actual and expanded (underlined) recoveries for spring chinook CWT groups harvested in the net fishery on the Klamath River portion of the Hoopa Valley Reservation in 1983.

Tag Code	Brood Year	Hatchery[1/] of Origin	Release[2/] Type	CWT Recoveries		Mean Fork Length	Standard Deviation
06-61-30	1978	TRH	Y	1	15	76.0	----
06-61-32	1979	TRH	F	1	15	82.0	----
06-61-33	1979	TRH	F[3/]	13	73	73.4	6.20
06-61-34	1979	TRH	Y	4	30	73.8	3.50
06-61-36	1979	TRH	Y+	2	10	63.0	1.41
06-61-39	1980	TRH	Y	2	10	56.0	1.41
07-20-23	1980	CRH	Y+	1	1	43.0	----
62-18-04	1979	BHSR	Y	1	1	82.0	----
TOTAL TAGS				25	155		
AD - NO TAGS				10	59		

1/ BHSR - Burnt Hill Salmon Ranch
CRH - Cole Rivers Hatchery (Rogue River System)
TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to early December release
Y+ (Yearling-Plus) - March release

3/ Off-site release at Trinity River kilometer 40.0 (Willow Creek)

TABLE 30. Contribution rate of CWT age 3 and 4 spring chinook to the Indian net fishery on the Klamath River portion of the Hoopa Valley Reservation.

Tag Code	Brood Year	Rearing[1/] Facility	Release[2/] Type	NUMBER HARVESTED[3/] 3	4	Total	Number[4/] Released Tagged	Contribution[5/] Rate
06-61-11	1978	TRH	F[6/]	163	47	210	192,800	0.109
06-61-12	1978	TRH	F	69	11	80	170,800	0.047
06-61-30	1978	TRH	Y	126	541	667	191,916	0.348
06-61-31	1978	TRH	Y+	25	351	376	134,948	0.279
06-61-32	1979	TRH	F	0	15	15	187,494	0.008
06-61-33	1979	TRH	F[6/]	40	73	113	181,134	0.062
06-61-34	1979	TRH	Y	44	30	73	86,594	0.084
06-61-36	1979	TRH	Y+	0	10	10	35,666	0.028
06-61-39	1980	TRH	Y	10	39	49	34,601	0.142
06-61-35	1981	TRH	F	0	-	0	182,635	0.000
06-61-37	1981	TRH	Y	9	-	9	98,637	0.009

1/ TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to November release
Y+ (Yearling-Plus) - March release

3/ Estimated number of coded-wire tagged spring chinook

4/ From Pacific Marine Fisheries Commission CWT release data

5/ Contribution rate = number harvested / number released tagged X 100

6/ Off-site release at Trinity River kilometer 40.0 (Willow Creek)

of release strategies (fingerling, fingerling off-site, yearling and yearling-plus) were attempted. From these releases, yearlings had the highest contribution rate closely followed by the off-site fingerling release. While the yearling release in 1980 had a higher contribution rate (0.142%) than the 1979 yearling release (0.084%), the TRH experienced a power failure whereby over half of the 1980 brood yearlings and all of the 1980 brood fingerlings perished before release. The failure of the hatchery release can be seen by comparing estimated harvests from the 1979 and 1980 brood years; 408 adult CWT spring chinook were harvested from the 1979 brood year and only 49 CWT spring chinook from the 1980 brood year, an 88.0% decrease. Contribution rates from 1981 appear low, although only a partial assessment can be made at this time because 4-year-olds are not due to return until 1985. There were no recoveries from the 1981 fingerling release and only 9 from the 1981 yearling release for an average contribution rate of 0.003%. The disparity between harvest of 1979 and 1980 brood year spring chinook points to the dependence of the Indian net fishery on hatchery stocks. Only a small naturally spawning spring chinook population appears to remain in the Klamath River system.

The age composition of CWT spring chinook salmon harvested in 1984 Indian net fishery was 94.2% 4-year-olds and 5.8% 3-year-olds; no 2- or 5-year-olds were caught in 1984. The gill net harvest was dominated by 4-year-old spring chinook in 1982 and 1983 as well.

Mean length of CWT recoveries from TRH yearling release spring chinook returning as 3-year-olds were 10.5 cm greater in 1984 than 1983, but nearly the same as in 1981 and 1982. None of the comparisons made proved significant differences ($p>0.05$). Mean length of TRH yearling release spring chinook returning as 4-year-olds was 1.8 cm less in 1984 than 1983 but 1.1 cm and 3.5 cm greater than 1981 and 1982 respectively; only the 1984 versus 1982 comparison was significant ($p<0.05$).

In-River Net Versus Ocean Fisheries

The overall annual ratio of ocean (commercial troll and sport catches combined) to Klamath River Indian gill net harvest of Klamath River CWT fall chinook in 1984 was the lowest in the 5 years that CWT have been recovered from the in-river net fishery (Table 31). The total harvest ratio for the past 5 years was 5.5:1 whereas the 1984 ratio was 1.7:1. The 1984 ratio reflects a below average harvest of CWT chinook in-river (702 versus an average of 951) and a large reduction in ocean harvest of Klamath River CWT stocks. The ratio of ocean:in-river harvest of CWT 3-year-olds is higher than that of 4-year-olds for a given brood year. This reflects a greater ocean harvest of 3-year-olds and lower ocean harvest of 4-year-old when compared to the in-river fishery (Table 32). As in past years 2-year-old CWT groups contributed little to either the ocean landing or in-river net harvest.

Klamath River CWT fall chinook groups contributed primarily to the fisheries operating between Fort Bragg, California, and Newport, Oregon; over 99% of total 1984 ocean recoveries occurred in landings at these ports (Figure 34). Of the Klamath River CWT fall chinook landed at these ports, 83% originated from IGH stocks. The majority of the ocean caught Klamath

TABLE 31. Estimated contributions of Trinity River Hatchery and Iron Gate Hatchery fall chinook CWT groups to the 1980-1984 ocean troll and Indian gill net fisheries.

	TRINITY RIVER HATCHERY			IRON GATE HATCHERY			TOTAL		
	Ocean[1/] Harvest	Gill Net[2/] Harvest	Ratio Ocean/Gill Net	Ocean Harvest	Gill Net Harvest	Ratio Ocean/Gill Net	Ocean Harvest	Gill Net Harvest	Ratio Ocean/Gill Net
1980	5,068	562	9.0:1	-	-	-	5,068	562	9.0:1
1981	4,413	1,587	2.8:1	2,410	311	7.7:1	6,823	1,898	3.6:1
1982	5,239	676	7.8:1	4,609	554	8.3:1	9,848	1,230	8.0:1
1983	1,767	153	11.5:1	1,519	208	7.3:1	3,286	361	9.1:1
1984	201	154	1.3:1	974	548	1.8:1	1,175	702	1.7:1
Total	16,688	3,132	5.3:1	9,512	1,621	5.9:1	26,200	4,753	5.5:1

1/ Combined commercial and sport returns in Washington, Oregon and California compiled from preliminary data provided by WDF, ODFW and CDFG.

2/ Includes only those fish landed on the Klamath River portion of the HVR.

TABLE 32. Estimated contributions of age 3 and 4 fall chinook CWT groups to the 1980-1984 ocean troll and Indian gill net fisheries.

	AGE AT HARVEST					
	3			4		
Brood Year	Ocean[1/] Harvest	Gill Net[2/] Harvest	Ratio Ocean/Gill Net	Ocean Harvest	Gill Net Harvest	Ratio Ocean/Gill Net
1976	---	---	---	2,547	270	9.4:1
1977	2,521	263	9.6:1	2,599	878	3.0:1
1978	4,109	871	4.7:1	2,707	748	3.6:1
1979	7,092	416	17.0:1	2,247	205	11.0:1
1980	997	140	7.1:1	672	411	1.6:1
1981	488	244	2.0:1	---	---	---
Total	15,207	1,934	7.9:1	10,772	2,512	4.3:1

1/ Combined troll and sport returns in Washington, Oregon and California compiled from preliminary data provided by WDF, ODFW and CDFG.

2/ Gill net harvest in 1980-1982 adjusted to reflect only those fish caught on the Klamath River portion of the Hoopa Valley Reservation.

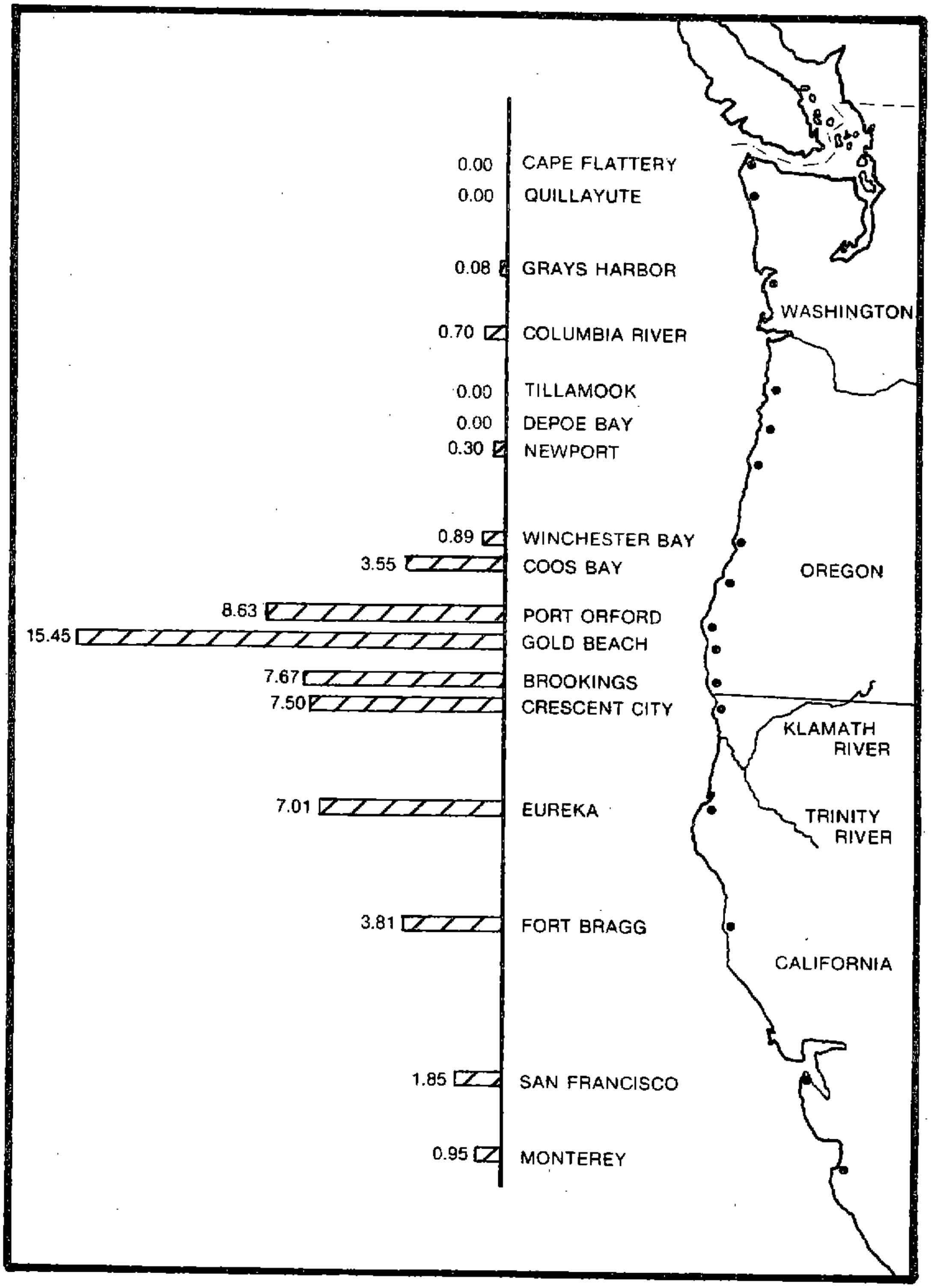


FIGURE 34. Relative contribution indices of CWT Klamath River fall chinook to 1984 ocean landings at California, Oregon and Washington ports (calculated from preliminary data provided by CDFG, ODFW and WDF).

River CWT fall chinook were landed in California (70.1%) followed by Oregon (29.0%) and Washington (0.9%).

The overall ratio of ocean-river harvest of Klamath River CWT spring chinook in 1984 decreased from 1983 (Table 33). The 1984 harvest ratio of 2.1:1 was also lower than the 1980-1984 total ratio of 3.6:1. As in past years ocean fisheries harvested spring chinook 3-year-olds at a higher ratio than 4-year-olds (Table 34). Jack CWT groups contributed little to either the ocean or in-river landings.

TABLE 33. Estimated contributions of Trinity River Hatchery spring chinook CWT groups to the 1980-1984 ocean troll and Indian gill net fisheries.

	TRINITY RIVER HATCHERY		
	Ocean 1/ Harvest	Gill Net 2/ Harvest	Ratio Ocean/Gill Net
1980	588	167	3.5:1
1981	2,273	419	5.4:1
1982	2,786	1,034	2.7:1
1983	724	153	4.7:1
1984	103	48	2.1:1
Total	6,474	1,821	3.6:1

1/ Combined commercial and sport returns in Washington, Oregon and California compiled from preliminary data provided by WDF, ODFW and CDFG.

2/ Includes only those fish landed on the Klamath River portion of the HVR.

TABLE 34. Estimated contributions of age 3 and 4 spring chinook CWT groups to the 1980-1984 ocean troll and Klamath River gill net fisheries.

	AGE AT HARVEST					
	3			4		
Brood Year	Ocean[1/] Harvest	Gill Net[2/] Harvest	Ratio Ocean/Gill Net	Ocean Harvest	Gill Net Harvest	Ratio Ocean/Gill Net
1976	---	---	---	469	153	3.1:1
1977	119	14	8.5:1	126	21	6.0:1
1978	2,072	383	5.4:1	345	950	0.4:1
1979	2,438	84	29.0:1	640	128	5.0:1
1980	57	10	5.7:1	38	39	1.0:1
1981	55	9	6.1:1	---	---	---
Total	4,741	500	9.5:1	1,618	1,291	1.3:1

1/ Combined troll and sport returns in Washington, Oregon and California compiled from preliminary data provided by WDF, ODFW and CDFG.

2/ Gill net harvest in 1980-1982 adjusted to reflect only those fish caught on the Klamath River portion of the Hoopa Valley Reservation.

CHINOOK SALMON HARVEST OVERVIEW

INTRODUCTION

The Hoopa Valley Reservation gill net fishery previously described in this report, and its impact on the Klamath River chinook population, are important considerations in management of the resource. Even more crucial in management is to view the total scope of fisheries impacts on this important population. To this end, data from all local fisheries operating on the Klamath River fall chinook population have been accumulated and are presented here in order to provide an overview of total harvest.

While in previous annual reports both spring and fall chinook adults and jacks have been included in similar overviews presented, this analysis will present data on adult fall chinook only. The reader should therefore exercise caution when comparing this analysis to those included in previous reports.

HARVEST OVERVIEW

The 1984 California ocean commercial troll fishery was regulated through various in-season closures and gear restrictions. The total of 290,700 chinook landed in 1984 represents an increase of 6% from 1983, but is only 52% of the 1979-1975 average. North Coast landings (Fort Bragg, Eureka and Crescent City ports) of 76,000 chinook were 31% below 1983 and only 26% of the 1971-1975 average. California 1984 ocean recreational landings of 89,300 chinook were up 44% from 1983 landings, including North Coast landings of 8,700 down 13% from 1983 (PFMC 1985).

The 1984 Oregon ocean commercial troll fishery was also regulated through various in-season closures and gear restrictions. Landings for the year totaled 63,600 chinook, a decline of 20% from 1983 and 70% below the 1971-1975 average. Landings in 1984 south of Coos Bay totaled 40,000 chinook, a decline of 4% from 1983. Oregon 1984 ocean recreational landings totaled 17,000 chinook, 31% below 1983 and 70% below the 1974-1975 average. The 1984 recreational landings south of Coos Bay totaled 13,900 chinook, a 27% decline from 1983 (PFMC 1985).

Several estimates of the contribution rate of Klamath River fall chinook to the ocean fisheries operating between Fort Bragg, California and Coos Bay, Oregon have been used by the Pacific Fishery Management Council (PFMC) and California Department of Fish and Game (CDFG) to analyze the influence of offshore regulations on Klamath River stocks during recent years - 40% (CDFG 1980), 30% (PFMC 1982) and 21% (CDFG 1983). These were generally derived through coded-wire tag (CWT) analyses. This report will use a 30% contribution in representing ocean landings during 1978-1984. It should be recognized that use of a 30% contribution value to landings during the 1978-1984 period may underestimate Klamath catch toward the beginning and overestimate Klamath catch toward the end of that period, but should be representative of these years on the whole. McConnaha (in USDI 1985), in a similar harvest overview analysis, used the 21% contribution rate. Since it appears that the Klamath chinook contribution rate may have declined during this period, the application of a 21% rate to landings during the 1979-1984 period would appear to provide a minimum estimate of Klamath River fall chinook contribution.

Through analysis of CWT return data, the CDFG has estimated that an average of 90% of the total ocean harvest of Klamath River fall chinook occurs in the Fort Bragg to Coos Bay area. The CH_2M Hill report (USDI 1985) used this figure, and the present analysis will assume the same.

Using the distribution and contribution factors derived from CWT data, and applying these to ocean commercial and recreational landings, the 1978-1984 combined ocean fisheries have landed approximately 141,000 Klamath River fall chinook annually. The numbers landed have declined markedly since 1982.

The Klamath River 1984 sport fishery harvest of 3,727 fall chinook was 21% below 1983 and the smallest catch since 1978. The 1984 adult harvest of 2,136 was the smallest since 1980, comprising 4.9% of the total in-river adult run. In-river fall chinook sport fishery harvest levels had risen steadily from 1978 to 1982 before declining during 1983-1984 (CDFG preliminary data, in PFMC 1985). The in-river sport fishery has harvested an average of 3,750 adult fall chinook per year during 1978-1984.

Klamath River Indian gill net fall chinook harvest, discussed previously in this report, rose 138% from 8,053 in 1983 to 19,125 in 1984. The net fishery has harvested an average of 16,850 adult fall chinook per year during 1978-1984.

The catches reported do not entirely reflect the total impact of these fisheries on the resource because such data do not account for noncatch mortality caused by the fisheries or the harvest of fish which would otherwise have died from natural causes prior to spawning. While such additional information is difficult to address and therefore generally not factored into harvest estimates, it is important to recognize that such impacts occur.

Noncatch mortality of chinook in the ocean troll fishery has been reported by Ricker (1976), O'Brien et al. (1970) and others, and appears to approximate 40%-50% of the coastwide ocean harvest. Most ocean noncatch mortality occurs primarily to fish which are caught, judged to be below the legal size limit, and released.

Noncatch mortality of chinook in the in-river sport fishery has not been estimated, but appears to be less of a factor than in the ocean fishery.

Noncatch mortality of chinook in the in-river net fishery occurs primarily through pinniped depredation on fish trapped in nets prior to removal. Herder (1983) estimated pinniped depredation to be 13.2% of the fall chinook gill net harvest on the Klamath. Additional mortality occurs to fish which drop out of or escape nets after entanglement. This source of mortality has not been estimated but appears to be equal to or less than that due to pinniped depredation (see Parker 1960, Jewell 1970, and French and Dunn 1973). Total noncatch mortality in the net fishery, as a factor in management, appears to be intermediate in magnitude between that of the ocean fishery and that of the in-river sport fishery.

One major difference between the ocean and river fisheries with regard to noncatch mortality concerns the existence of size limits in the ocean, while the river fisheries have none. Therefore, fish captured in the river fisheries which are below the legal size limits of the ocean fisheries are generally kept. This, along with the fact that the majority of noncatch mortality in the ocean fisheries occurs to fish which are below the legal size limit and released after capture, makes direct comparison of total harvest data from ocean and river fisheries difficult and potentially misleading. In order to deal with this complication, two strategies may generally be employed. In one, noncatch mortality of sub-legal chinook in the ocean fisheries is estimated, added to landings data, and the resulting figure is compared to total in-river harvest. In the other method, jacks (which roughly correspond in size to sub-legal chinook in the ocean fisheries) are subtracted from total in-river harvest data, and the resulting figure is compared to ocean landing data. The latter method has been employed for purposes of comparison in this analysis.

Harvest of fish which would otherwise have died of natural causes prior to spawning is even more difficult to address than noncatch mortality. Presumably, this is a more significant factor regarding the ocean fisheries than the in-river fisheries, since the in-river fisheries operate on a fully mature, terminal population. This factor will not be addressed in this analysis.

Tables 35 and 36 present an overview of the harvest data discussed herein. These data result in mean annual ratios of 2.3:1 ocean landings to river returns, 6.8:1 ocean landings to in-river harvest, and 4.0:1 total fishery harvest to spawner escapement (Figure 35). For purposes of comparison, employment of a 21% Klamath River fall chinook ocean contribution rate in a similar analysis yields respective ratios of 1.6:1, 4.8:1 and 3.0:1.

TABLE 35. Estimated numbers of Klamath River fall chinook in total ocean landings, 1978-1984.

Year	TOTAL CHINOOK LANDINGS				N. Ca./S. Or. Area Total	Klamath Area Contribution	Klamath Total Contribution
	N. Ca. Troll	N. Ca. Sport	S. Or. Troll	S. Or. Sport			
$\bar{X}$ 1971-1975	298,600	15,800	153,000	17,400	484,800	145,440	161,600
1978	346,700	7,400	114,100	12,100	480,300	144,100	160,100
1979	492,800	15,900	192,500	10,900	712,100	213,600	237,300
1980	290,900	8,800	143,200	10,100	453,000	135,900	151,000
1981	292,500	11,300	110,400	13,400	427,600	128,300	142,600
1982	344,200	20,900	178,700	25,600	569,400	170,800	189,800
1983	109,700	10,000	41,800	19,000	180,500	54,200	60,200
1984	76,000	8,700	40,000	13,900	138,600	41,600	46,200
$\bar{X}$ 1978-1984	278,970	11,860	117,240	15,000	423,070	126,900	141,000

TABLE 36. Estimated contribution of Klamath River adult fall chinook to the ocean, inland sport and Indian gill net fisheries, 1978-1984.

Year	Klamath Ocean Catch	In-River Run Size	In-River Sport Catch	In-River Gill Net Catch	Total Spawning Escapement	Ratio Between Ocean Catch and In-River Run Size	Ratio Between Total Catch and Spawning Escapement
1978	160,100	91,340	1,690	18,200	71,450	1.8:1	2.5:1
1979	237,300	50,060	2,140	13,650	34,270	4.7:1	7.4:1
1980	151,000	42,090	2,090	12,010	27,990	3.6:1	5.9:1
1981	142,600	77,300	5,980	33,030	38,280	1.8:1	4.7:1
1982	189,800	62,700	7,890	14,480	40,530	3.0:1	5.2:1
1983	60,200	57,920	4,340	7,890	45,680	1.0:1	1.6:1
1984	46,200	43,290	2,140	18,670	22,670	1.1:1	3.0:1
$\bar{X}$ 1978-1984	141,000	60,670	3,750	16,850	40,120	2.3:1	4.0:1

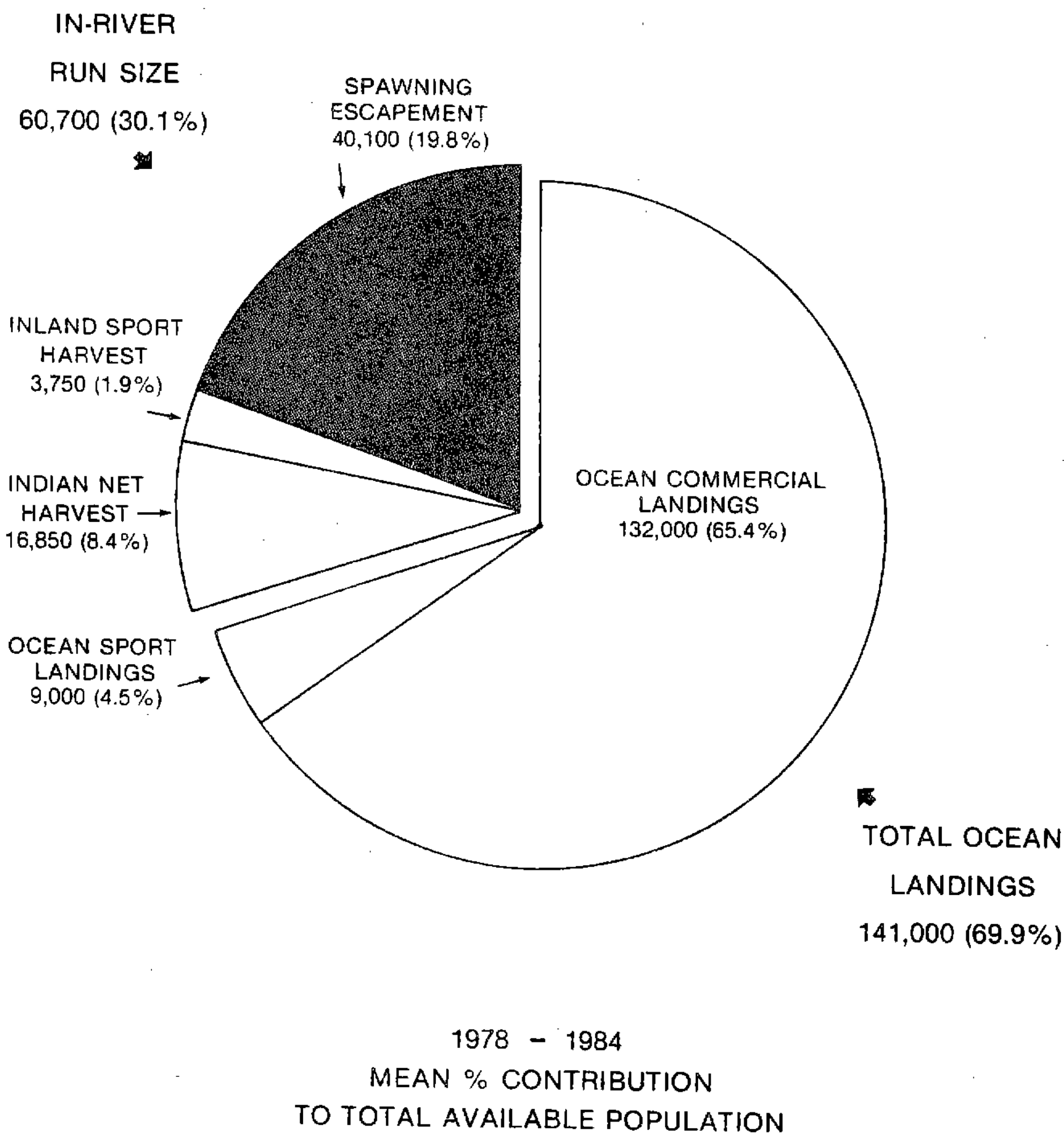


FIGURE 35. Estimated mean annual contributions of Klamath River adult fall chinook to the ocean and in-river fisheries compared with spawning escapement during 1978-1984.

PLATE 5. Indian gill net fishing on the Hoopa Valley Reservation during 1984.

EL NIÑO

INTRODUCTION

During the El Niño of 1982-1983 a breakdown of the normal weather patterns and a shift of wind and water currents caused a reduction in the upwelling that normally occurs along the north coast. As a direct result of these phenomena, water temperatures became elevated and a reduction in nutrients associated with the cooled upwelled waters occurred, affecting the availability of food items for many fish species, including salmonids. In 1983 these conditions contributed to a decrease in salmon landings along the Pacific coast of California to southern Alaska, as well as a reduction in the average size of the salmon caught. The effects on the Klamath River fall chinook were evident in the data collected by FAO-Arcata in 1983. These included a significant decrease in size at age, reduced growth rates and a northerly shift in ocean distributions. Refer to the El Niño section of the 1983 annual report (USFWS 1984) for a description of the El Niño event and impacts observed during 1983.

With the return of near normal weather and ocean conditions in 1984, a trend toward resumption of normal growth patterns may be expected. The 1984 data on the Klamath River fall chinook stocks was analyzed in an attempt to identify any increases in size at age, increased growth rates and shifts back to pre-El Niño ocean distributions, which may be associated with the return of normal ocean conditions. Following is a summary of findings from the 1984 data which pertain to El Niño.

METHODS

Methods utilized in treating beach seine, coded-wire tag recovery (CWT), age composition and length frequency data for use in describing El Niño impacts were the same as described in previous sections of this report.

RESULTS AND DISCUSSION

Data collected in the beach seining program gave the first indication that Klamath River fall chinook populations had responded to the improved ocean conditions in 1984. Mean fork lengths of jacks and adults captured by beach seine in 1984, 45.5 cm and 68.3 cm respectively, were significantly larger than those captured in 1983, 41.1 cm and 64.9 cm (t-test, $p<0.05$). While improved growth was evident in comparing 1984 to 1983 populations, jack and adult chinook returning in 1984 were significantly smaller ($p<0.05$) than those returning in 1979-1982.

Length frequency data on fall chinook collected at the Shasta River weir in a cooperative effort between the United States Fish and Wildlife Service (USFWS) and California Department of Fish and Game (CDFG) during 1982, 1983 and 1984 (Figure 36) also showed that jack and adult mean lengths increased in 1984. Mean length of adults in 1984, 65.2 cm, was greater than in 1983, 64.3 cm, although not significantly (t-test, $p>0.05$) while mean length of

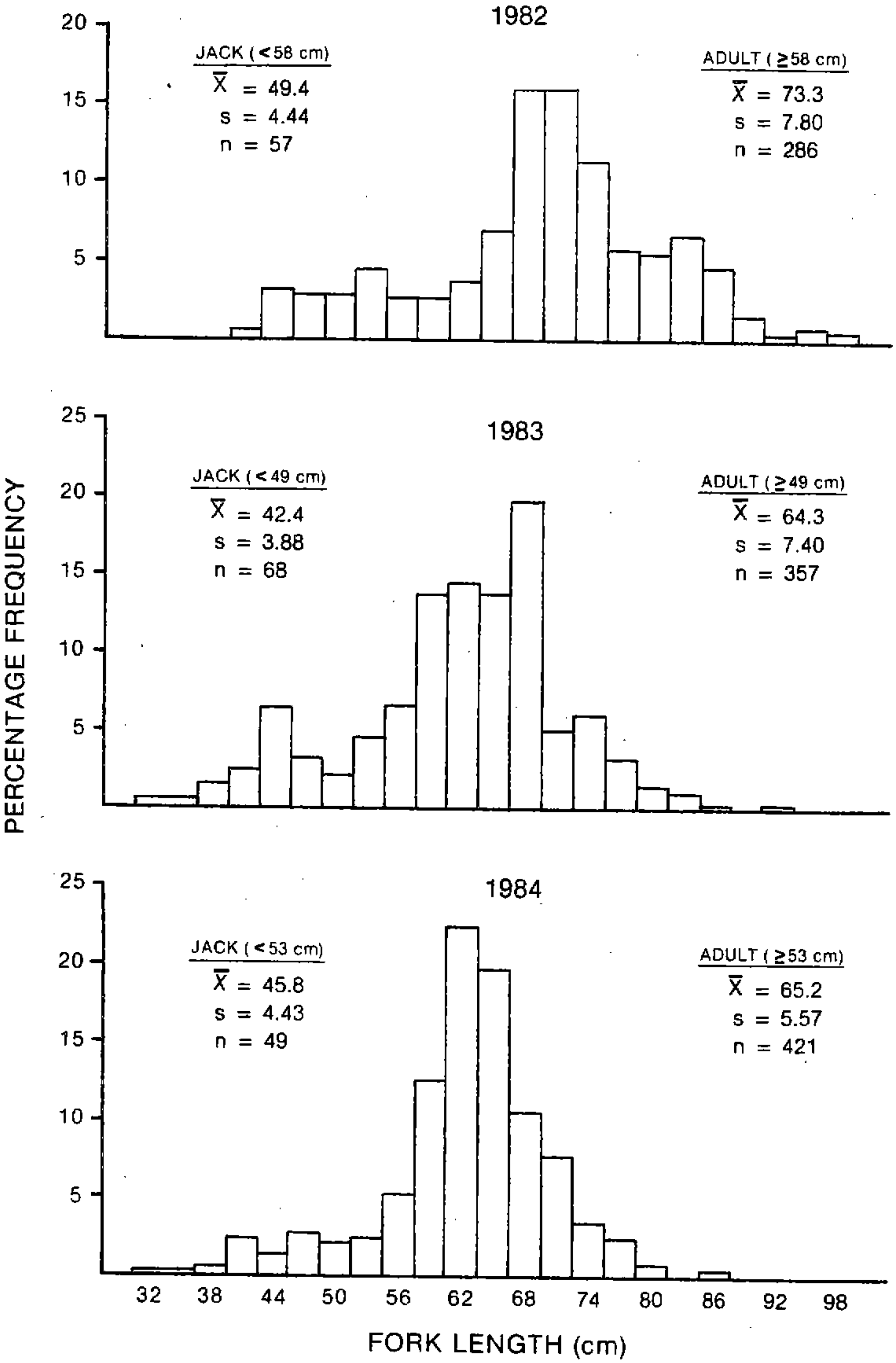


FIGURE 36. Length frequency distributions of fall chinook salmon measured at the Shasta River weir during 1982-1984 (3 cm groupings with midpoints noted).

jacks, 45.8 cm, was significantly greater than in 1983, 42.4 cm (t-test, $p<0.05$). Mean lengths of fall chinook jacks and adults in 1984, 45.8 cm and 65.2 cm respectively, were significantly less than those recorded in 1982, 49.4 cm and 73.3 cm ($p<0.05$). The Shasta River data, therefore, corroborates that from the beach seining program in identifying partial recovery of size in the Klamath River fall chinook population.

Continued impacts from El Niño were evident in the CWT analysis. The growth rate of 3- to 4-year-old fingerling and yearling CWT release type fall chinook during the last four growing seasons were compared (Table 37). Both yearlings and fingerling fall chinook grew at rates similar to pre-El Niño conditions, indicating a recovery of ocean growth conditions. However, mean lengths at age were still depressed to near 1983 levels (see CWT investigation section). This reinforces the 1983 analysis which showed that Klamath River chinook ended the 1983 growth year in poor condition. Also in last year's CWT analysis a northerly shift in Klamath River stocks was noted. A similar analysis is difficult to prepare for 1984 because of reduced chinook landings at Oregon ports; however, general indications are that Klamath chinook were somewhat more southerly in ocean distribution during 1984 than in 1983.

Table 38 presents mean lengths for chinook returning to the Klamath River in 1983 and 1984 by age class and combined mean lengths for the respective age classes for the pre El Niño years 1979-1982. Percentage changes from the mean of the pre-El Niño years and 1983 and 1984 are also recorded. A smaller percentage decrease from the 1979-1982 mean fork length for 2-year-olds in 1984 indicates a faster recovery in growth and associated lengths than for 3- or 4-year-olds. As discussed in the 1983 Annual Report (USFWS 1984) 2-year-old chinook returning in 1983 were affected by El Niño during a greater percentage of their life and therefore were more adversely impacted than 3- or 4-year-olds returning that year. The apparent faster recovery by the 2-year-olds returning in 1984 may be attributable to improved ocean conditions during a period of rapid growth and development. The low abundance of 2-year-old returns in 1983 and 1984 may be partially a result of the poor ocean survival conditions present during critical portions of these groups' life cycles.

It is evident that the fall chinook entering the Klamath River in 1984 exhibited a return toward pre-El Niño growth rates and size at age. However, the length of time needed for full recovery to pre-El Niño conditions is unknown and could last several years. Further data analysis and monitoring of the stocks is needed.

Table 37. Growth between ages 3 and 4 for CWT fall chinook captured by Indian fishers on the Klamath River portion of the Hoopa Valley Reservation during 1981-1984.

Growth Year	GROWTH RATE (cm/yr)	
	Fingerling	Yearling
1981	14.8	13.7
1982	16.1	15.0
1983	3.4	8.3
1984	12.3	13.8

TABLE 38. Mean lengths of 2-, 3-, and 4-year-old chinook returning in 1979-1982 (pre-El Niño years) and in 1983 and 1984, and percent changes for 1983 and 1984 from the 1979-1982 mean by age group.

Age	1979-1982 Mean	1983	Percentage Change From 1979-1982 Mean	1984	Percentage Change From 1979-1982 Mean
2	49.1	41.9	14.66	45.4	7.54
3	69.2	60.3	12.86	62.9	9.10
4	81.3	71.5	12.05	72.6	10.70

COHO SALMON INVESTIGATIONS

ABSTRACT

A total of 212 coho salmon, including 171 jacks, were captured during 1984 beach seining operations in the Klamath River estuary. Adipose fin-clipped coho comprised 19.6% of the beach seine sample and 14.7% of the total sample was hook scarred. Scale samples were collected from 204 coho and used in age composition analysis. Age composition for returning coho was 84.1% 2-year-olds, 15.4% 3-year-olds and 0.5% 4-year-olds. Jaw tags were placed on 166 coho and 14 tags were recovered. An estimated 399 coho salmon, including 40 jacks, were harvested by Indian gill netters on the Klamath River portion of the Hoopa Valley Reservation. Adipose fin-clipped coho comprised 38.5% of the harvest sample. A total of 13 coded-wire tags (CWT) were recovered expanding to an estimated Klamath River harvest of 119 CWT marked coho salmon. Three-year-old coho comprised the entire CWT harvest estimate.

COHO SALMON INVESTIGATIONS

INTRODUCTION

The 1984 coho salmon run in the Klamath River was monitored through the previously described net harvest monitoring and beach seining programs. Coho are less important to the Indian net fishery as coho enter the river in fewer numbers than chinook salmon and are of lesser cultural importance. Although a target species for some, most Indian fishers have curtailed fishing activities prior to the height of the coho run.

METHODS

Methods utilized in collecting and treating beach seine, net harvest, and coded-wire tag (CWT) data are the same as those described previously in the chinook salmon section of this report.

RESULTS AND DISCUSSION

Beach Seining

A total of 212 coho salmon including 171 jacks (<53 cm) were captured in the 1984 beach seining operations near the mouth of the Klamath River from August 30 through September 27, 1984.

Jacks sampled in 1984 had a mean length (45.0 cm) significantly greater (t-test, $p<0.05$) than jacks examined in 1983 (37.5 cm). The mean length of adults ($\geq$ 53 cm) sampled in 1984 (59.8 cm) was greater than in 1983 (56.4 cm); however, no significant difference ($p>0.05$) could be detected primarily due to the small sample size (Figure 37).

Of 36 adult coho examined, 16 (44.4%) were adipose fin-clipped and 10 (27.8%) were hook-scarred. Jaw tags were placed on 166 of the 204 coho examined. Fourteen tags were recovered for a recovery rate of 8.4%. The coho migration time showed a mean of 16.2 days to the confluence of the Klamath and Trinity Rivers for a mean migration rate of 6.0 km/day. Chinook migration time indicated a mean of 23.2 days for a mean migration rate of 4.8 km/day over the same distance (70 km). Migration rates and associated data are included in Table 39. Same-day recaptures in Area K-1 (for a description of river areas, i.e. K-1, see chinook-beach seining section, Figure 9) were eliminated from the data to treat any tendency of coho to linger in the lower estuary. The capture of 212 coho salmon during the 1984 beach seining activities represents the largest coho catch since the program began in 1979.

Scales were collected from 204 coho sampled for use in scale analysis to determine age composition and growth trends (see "Methods" section of age composition section). Of the 204 scale samples collected, 201 were used in age composition analysis. The age composition of coho returning in 1984 showed an abundance of 2-year-old (84.1%), followed by 3-year-old (15.4%), and 4-year-old (0.5%) salmon. Mean lengths for coho salmon returning at each

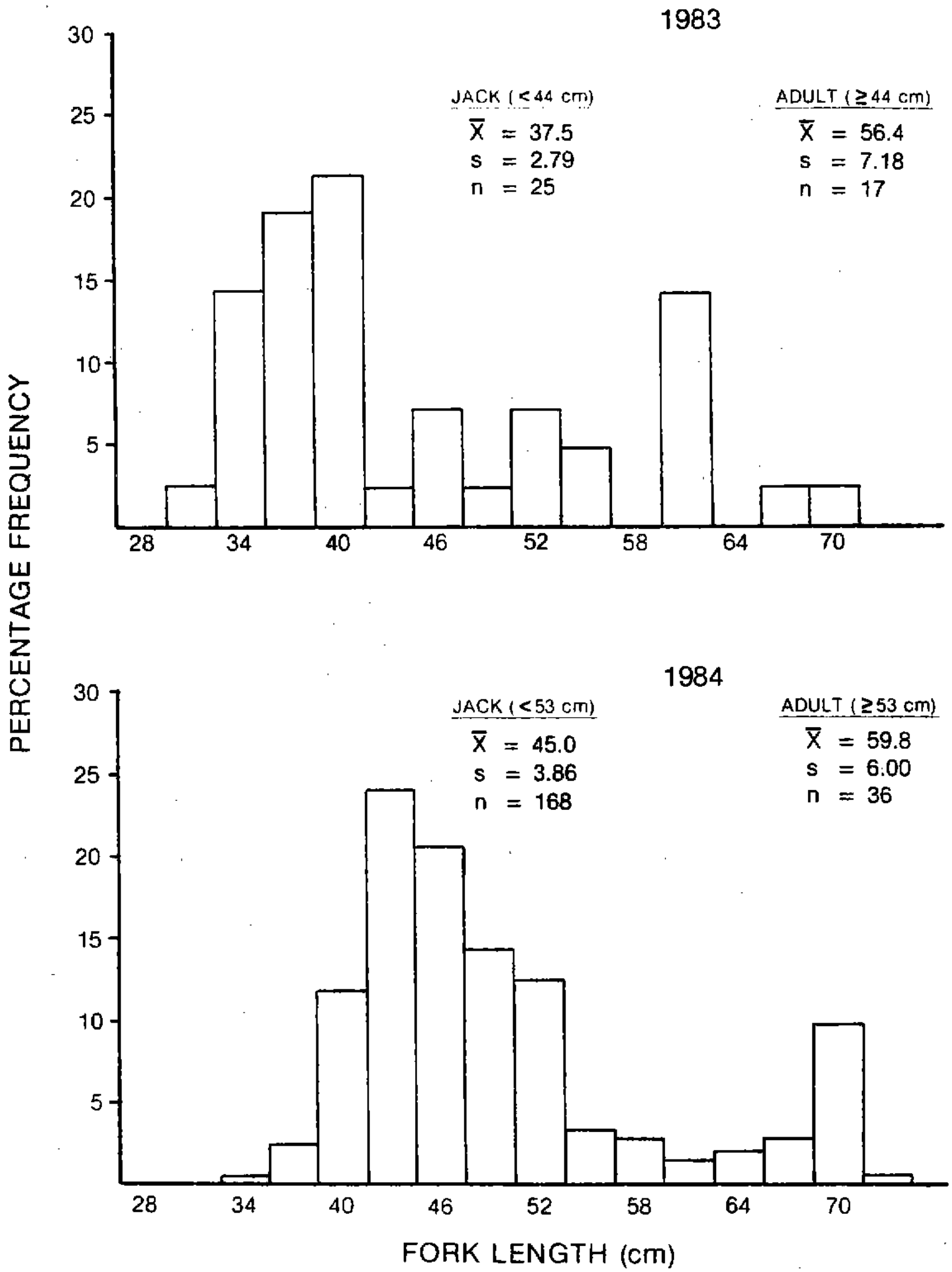


FIGURE 37. Length-frequency distributions of coho salmon captured during beach seining operations in the Klamath River estuary during 1983 and 1984 (3 cm groupings with midpoints noted).

TABLE 39. Migration data from 14 coho salmon tagged and recaptured in the Klamath-Trinity basin in 1984.

Area	Kilometers From River Mouth	Tag Recoveries	MIGRATION TIME (Days)		MIGRATION RATE (Km/Day)	
			Range	Mean	Range	Mean
K-1 1/	0 - 5	2	N/A 2/	N/A 2/	N/A	N/A
K-2	5 - 13	1 3/	-	-	-	-
K-3 to IGH	13 - 306	0	-	-	-	-
T-1	70 - 134	6	11-23	16.2	4.7-6.7	6.0
T-2 to T-3	134 - 249	0	-	-	-	-
TRH	249	5	37-67	49.8	3.7-6.7	5.2

1/ For a description of river areas see chinook-beach seining section.

2/ Does not include coho recaptured on the same day they were tagged.

3/ Insufficient information for calculating migration data.

age were 45.2, 58.5 and 73.0 cm respectively. The age group contributions and associated mean lengths presented may not be representative of the entire Klamath River coho population as the beach seining operation targets on chinook salmon and sampling is terminated prior to the peak of the coho run.

Net Harvest

An estimated 399 ±95 coho salmon were netted on the Klamath River portion of the Hoopa Valley Reservation. Coho caught in the Upper Klamath River net fishery accounted for 74.7% (298) of the total harvest estimate. Jacks (<53 cm) comprised 10% of the total estimated Reservation-wide harvest. Coho first appeared in the Klamath net fishery in mid-July. Large numbers did not appear until late September, with peak catches occurring in mid-to-late October (Table 40). Coho are considered of lesser importance than chinook salmon to the net fishery. This is due to a smaller run size of coho and Native ritual, belief, and ceremony connected with chinook salmon (Swezey 1977). Figure 38 and Figure 39 show that 1984 net fishing effort decreased greatly when chinook abundance dropped off, prior to the bulk of the coho run entering the river.

A total of 143 coho were sampled during the 1984 net harvest program. Mean lengths of adults (69.1 cm) were significantly greater than observed in 1983 (61.0 cm) (t-test; $p<0.05$), significantly less than observed in 1981 (70.7 cm) ($p<0.05$), and showed no significant difference from 1982 data (67.2 cm) ($p>0.05$; Figure 40).

Adipose fin-clipped coho comprised 38.5% of the total harvest sample. Mean lengths for adipose fin-clipped coho (69.4 cm) were significantly greater than non-clipped fish (65.2 cm) ($p<0.05$). In 1981, 1982 and 1983 adipose fin-clipped adults sampled did not differ significantly in mean length from non-clipped fish ($p>0.05$) (USFWS 1984).

A total of 13 coded-wire tags (CWT) were recovered from coho salmon in the Klamath River net fishery in 1984. These recoveries expand to an estimated harvest of 119 CWT coho. Four release groups from Trinity River Hatchery (TRH) had mean lengths of 65 cm (06-56-03), 73 cm (06-56-04), 67.3 cm (06-56-06), and 47 cm (06-56-46) while two release groups from Iron Gate Hatchery (IGH) had mean lengths of 73.3 cm (06-59-53) and 70.0 cm (06-59-55). One CWT each from Cole Rivers (CR) (07-26-26; 56 cm) and Rock Creek (RC) (07-26-40; 73 cm) was represented (CR and RC coho are treated as previously described in the chinook coded-wire tag section of this report). Three-year-old coho (1981 brood) comprised the entire CWT harvest sample. Contribution rates and associated CWT data are included in Table 41.

Table 42 summarizes net harvest estimates of coho salmon for the years 1980-1984.

TABLE 40. Semi-monthly set and drift net harvest estimates of coho salmon captured in the three Klamath River monitoring areas of the Hoopa Valley Reservation in 1984.

	NET HARVEST MONITORING AREA						
Time Period	Estuary	Middle Klamath Set Net	Middle Klamath Drift Net	Upper Klamath Set Net	Upper Klamath Drift Net	Semi-Monthly Totals (All Areas)	Cumulative Seasonal Total
July 16 - 31	**4** 1/ 1 2/ 25.0% 3/ 2 4/	- - - -	- - - -	- - - -	- - - -	**4**	**4**
August 1 - 15	**2** 1 50.0% 1	**0** - - -	**0** - - -	**0** - - -	**0** - - -	**2**	**6**
August 16 - 31	**2** 1 50.0% 1	**0** - - -	**0** - - -	**0** - - -	**0** - - -	**2**	**8**
September 1 - 15	**23** 3 13.0% 12	**3** 1 33.3% 2	**0** - - -	**1** 0 0% 1	**0** - - -	**27**	**35**
September 16 - 30	**11** 3 36.7% 4	**51** 10 19.6% 18	**0** - - -	**8** 3 37.5% 5	**21** 5 23.8% 6	**91**	**126**
October 1 - 15	- - - -	**5** 3 60.0% 1	**0** - - -	**22** 7 31.8% 28	**31** 2 6.5% 19	**58**	**184**
October 16 - 31	- - - -	- - - -	- - - -	**162** 38 23.5% 50	**53** 17 32.1% 26	**215**	
Area Season Total	**42** 9 21.4% 20	**59** 14 23.7% 21	- - - -	**193** 48 24.9% 84	**105** 24 22.9% 51		**399** 95 23.8% 176

1/ Harvest estimate.
2/ 95% Confidence interval.
3/ Confidence interval percentage.
4/ Accounted number of coho salmon.

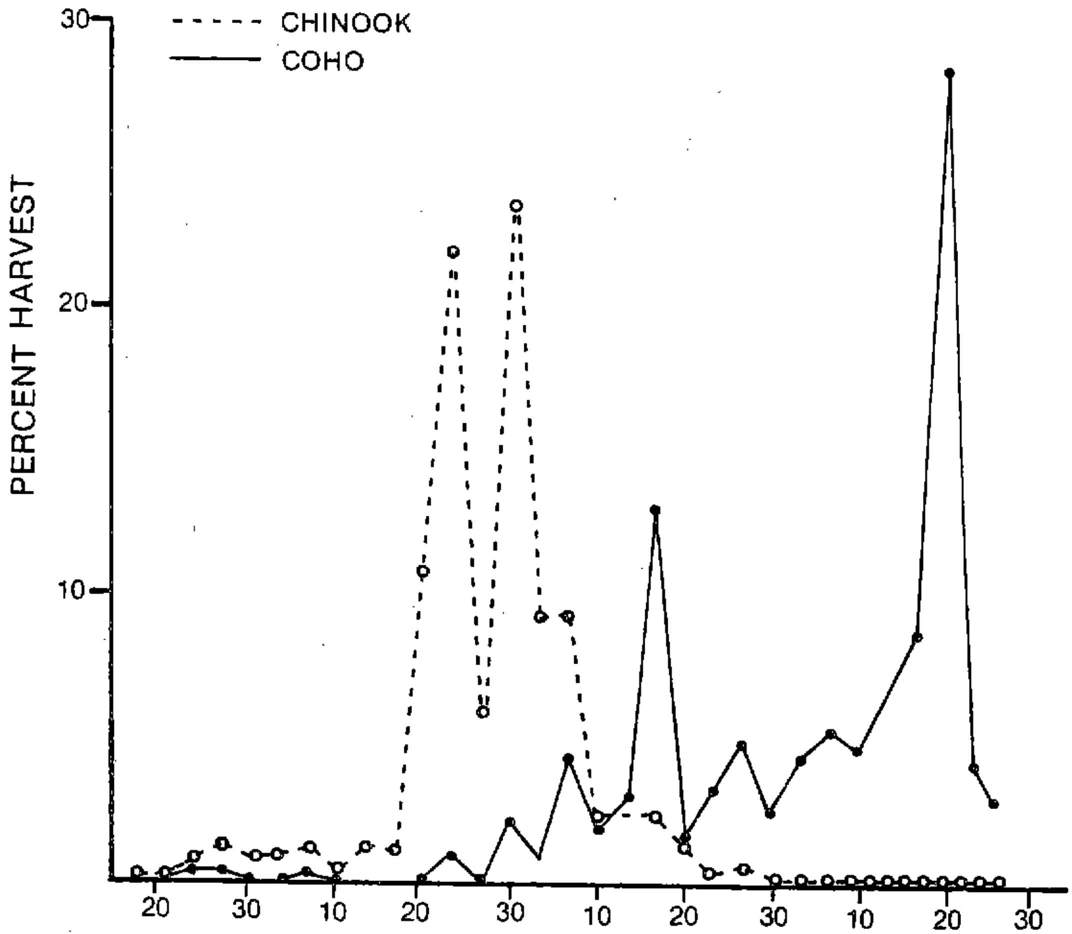


FIGURE 38. Three-day moving average of the estimated percentage of chinook and coho salmon caught by Indian fishers on the Klamath River portion of the Hoopa Valley Reservation.

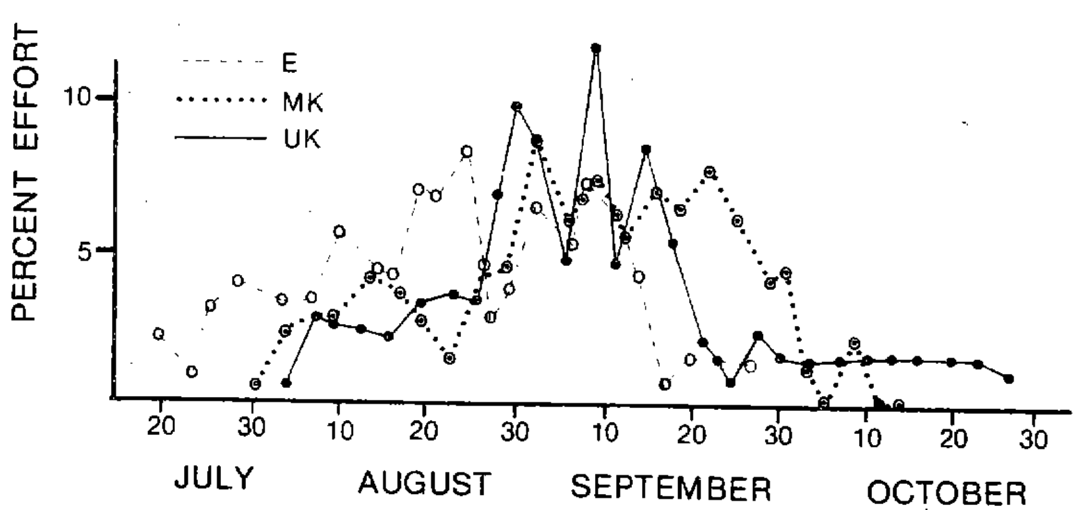


FIGURE 39. Three-day moving average of the estimated percentage effort in the estuary (E), Middle Klamath (MK), and Upper Klamath (UK) Areas of the Klamath River in 1984.

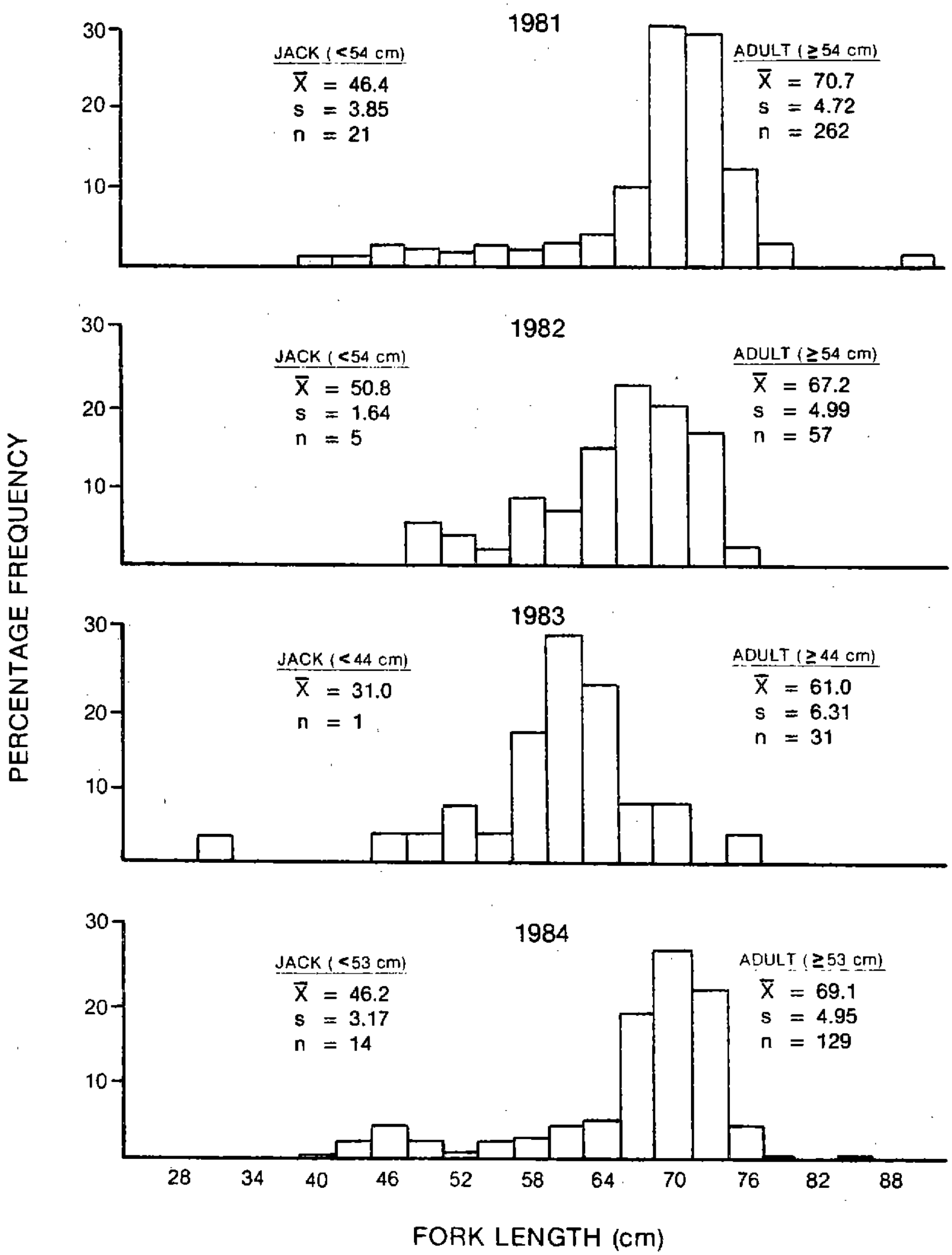


FIGURE 40. Length-frequency distributions of coho salmon caught by Indian gill net fishers on the Klamath River portion of the Hoopa Valley Reservation during 1981-1984 (3 cm groupings with midpoints noted).

TABLE 41. Contribution rate of coho salmon caught in the Indian gill net fishery on the Klamath River portion of the Hoopa Valley Reservation in 1984.

Tag Code	Brood Year	Rearing[1/] Facility	Release[2/] Type	Number[3/] Harvested		Number Released Tagged	Contribution[4/] Rate
06-56-03	1981	TRH	Y	1	9	38,491	0.023
06-56-04	1981	TRH	Y	1	9	31,924	0.028
06-56-06	1981	TRH	Y	3	33	33,949	0.097
06-56-46	1981	TRH	Y	1	14	47,312	0.030
06-59-53	1981	IGH	Y	3	33	18,920	0.174
06-59-55	1981	IGH	Y	2	19	18,870	0.101
07-26-26	1981	CR	Y	1	1	24,930	0.004
07-26-40	1981	RC	Y	1	1	26,643	0.004

1/ TRH - Trinity River Hatchery
IGH - Iron Gate Hatchery
CR - Cole Rivers Hatchery
RC - Rock Creek Hatchery

2/ Y (Yearling) - All fish released from February through June

3/ Estimated number of coded-wire tagged coho salmon

4/ Contribution rate = number harvested / number released tagged X 100

TABLE 42. Final harvest estimates of coho salmon taken in the gill net fishery of the Hoopa Valley Reservation during 1980-1984 1/.

	COHO CHINOOK		
Year	Jacks	Adults	Total
1980	-	-	1,500 2/
1981	163	1,470	1,633 3/
1982	49	951	1,000 4/
1983	4	121	125 5/
1984	261	738	999 6/

1/ Estimates for 1983 and 1984 Trinity net fishery were obtained from Hoopa Valley Business Council, Fisheries Department.

2/ Estimation methods described in 1980 Annual Report.

3/ Estimation methods described in 1981 Annual Report.

4/ Estimation methods described in 1982 Annual Report.

5/ Estimation methods described in 1983 Annual Report.

6/ Estimation methods described in 1984 Annual Report.

STEELHEAD TROUT INVESTIGATIONS

ABSTRACT

A total of 362 steelhead trout, including 109 half-pounders, were captured during 1984 beach seining operations in the Klamath River estuary. Mean lengths for adults and half-pounders were 49.7 cm and 36.0 cm respectively. Steelhead were captured throughout the course of the beach seining operation beginning in mid-July with peak catches occurring in late August and early September. The estimate for fall steelhead captured in the 1984 Indian gill net fishery on the Klamath River is 582, including 110 half-pounders. Adults comprised 161 fish in the harvest sample, with a mean length of 59.9 cm, while 40 half-pounders sampled showed a mean length of 35.2 cm.

STEELHEAD TROUT INVESTIGATIONS

INTRODUCTION

The 1984 steelhead trout run was monitored through the previously described net harvest monitoring and beach seining programs. Fall steelhead are seldom targeted by Indian netters and harvest is considered incidental to that of fall chinook salmon. Similarly, fall steelhead have not been the target species of FAO-Arcata beach seine operations.

METHODS

Methods used in collecting and analyzing beach seine and net harvest data for fall steelhead trout are the same as described for chinook salmon previously in this report.

RESULTS AND DISCUSSION

Beach Seining

A total of 362 fall steelhead trout including 109 half-pounders (< 44 cm), were captured during 1984 beach seining operations from July 17 through September 28. This represents an overall catch/effort value of 1.16 steelhead per seine haul (Table 43), which is similar to other catch/effort values observed during the 6-year study period. Peak steelhead catches in the beach seine sample occurred during two pulses, the greatest occurring from August 28 to September 5 (Figure 41).

Adult steelhead (≥44 cm) sampled in 1984 showed a mean length (53.5 cm) significantly greater ($p<0.05$) from those sampled in 1981 (49.7 cm) and 1982 (47.6 cm) but showed no significant difference in mean length from 1983 fish (53.8 cm) (t-test; $p>0.05$). The mean length of half-pounder steelhead (38.7 cm) was significantly greater ($p<0.05$) than those sampled in 1981 (36.0 cm), 1982 (35.0 cm), and 1983 (34.7 cm) (Figure 42).

Length information on fall steelhead half-pounders captured in the beach seine should be viewed with caution as many are released unmeasured. This practice is necessary due to the simultaneous occurrence of large numbers of fall chinook salmon in the seine which often physically damage the smaller steelhead. These small half-pounders also tend to become gilled in the seine net and, as a result, are too stressed to handle without a high rate of mortality. This practice tends to inflate the sample mean length of half-pounders, but is necessary to minimize half-pounder mortality.

Past information collected by FAO-Arcata biologists has shown differences in river entry behavior patterns between Klamath River fall steelhead and fall chinook salmon (USFWS 1983). This information, describing behavior difference between species, may be of interest to researchers wishing to target on fall steelhead in the Klamath River estuary.

TABLE 43. Numbers of steelhead captured during beach seining operations in the Klamath River estuary during 1979-1984 (catch per seine haul in parenthesis).

Year	Half-Pounder		Adult		Total	
1979 1/	318	(0.81)	345	(0.88)	663	(1.69)
1980	87	(----)	547	(----)	758	(1.18) 2/
1981	174	(0.56)	238	(0.77)	412	(1.34)
1982	59	(0.22)	240	(0.92)	299	(1.15)
1983	84	(0.28)	110	(0.36)	194	(0.61)
1984					362	(1.16)

1/ Includes data from two sites:

South Spit - 12 half pounders, 48 adults
North Spit - 306 half pounders, 297 adults

2/ Total includes 124 fish released unmeasured or not identified as to size group (i.e. half-pounders or adults).

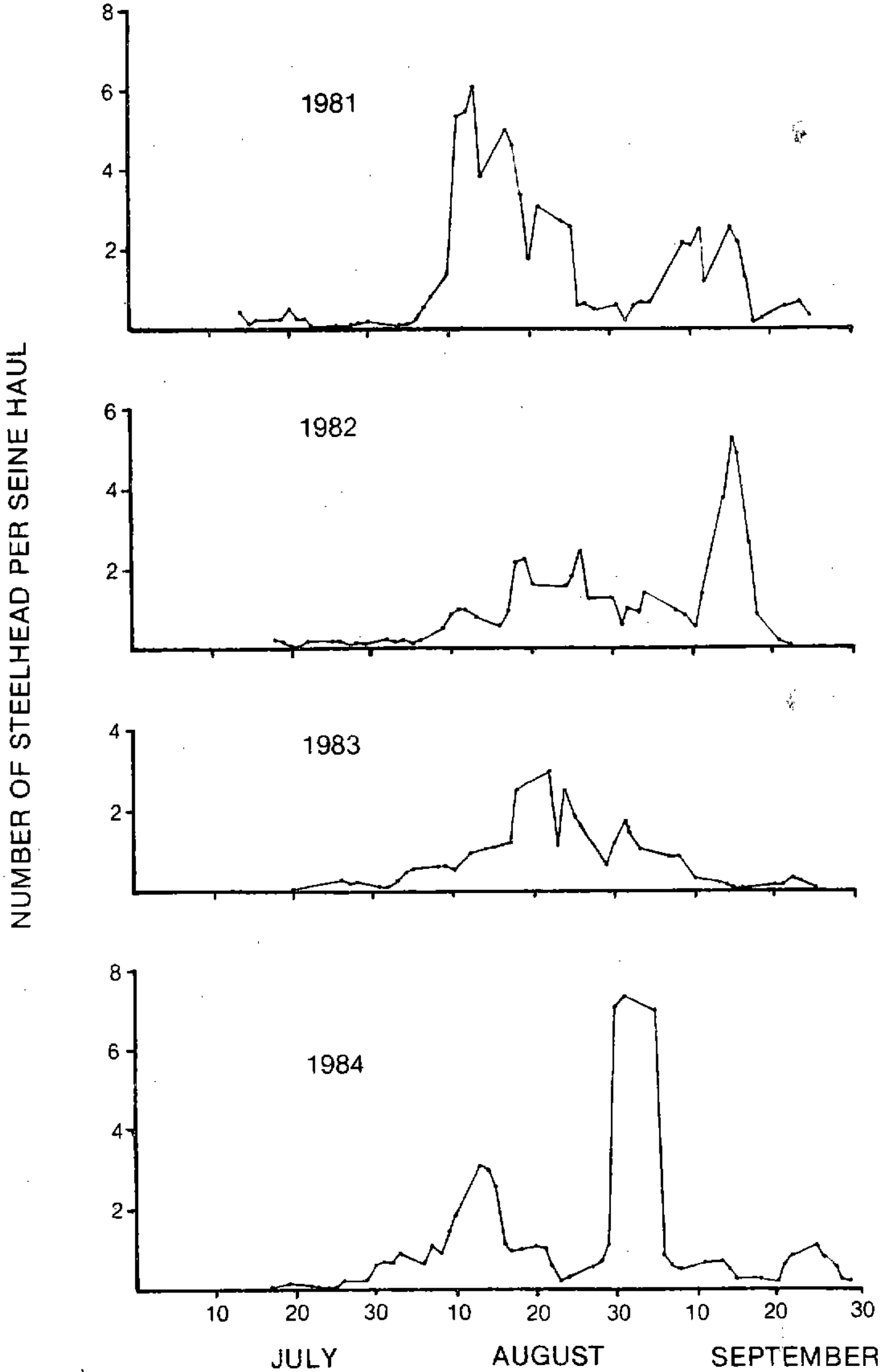


FIGURE 41. Three-day moving averages of numbers of fall steelhead trout captured per beach seine haul in the Klamath River estuary during 1981-1984.

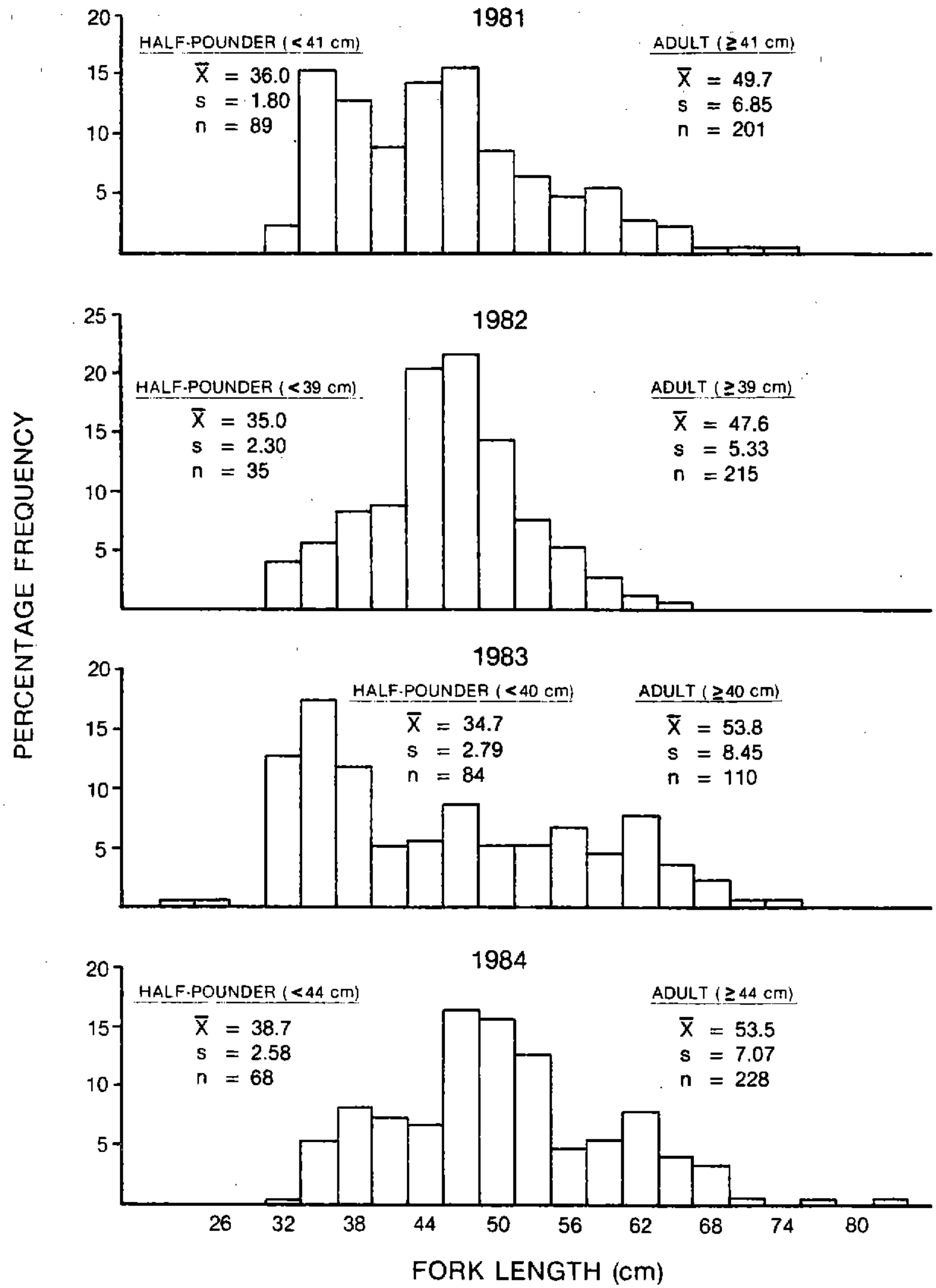


FIGURE 42. Length-frequency distributions of fall steelhead trout captured during beach seining operations in the Klamath River estuary during 1981-1984 (3 cm groupings with midpoints noted).

Net Harvest

The 1984 fall steelhead net harvest estimate is 582 (±91) fish with half-pounders (<44 cm) comprising 18.9% of the catch. Fall steelhead were observed from mid-July to the end of October in the Klamath River gill net fishery (Table 44). Determination of a run peak period is difficult to ascertain since harvest totals were relatively uniform throughout the net harvest monitoring period. Harvest levels appeared to coincide primarily with fluctuations in fishing effort.

Adult steelhead harvested by Indian gill netters in 1984 (59.9 cm) showed no significant difference in mean length from those sampled in 1983 (58.2 cm) (t-test; $p>0.05$), but were significantly greater in mean length than either the 1981 (56.9 cm) or the 1982 (51.3 cm) samples ($p<0.05$) (Figure 43). The 1984 half-pounder sample (35.2 cm) showed no significant difference in mean length when compared to 1981 (34.0 cm) or 1983 (34.0 cm) data ($p<0.05$) but was significantly greater in mean length than in 1982 (32.0 cm) ($p<0.05$).

Table 45 summarizes net harvest estimates of steelhead trout during the period 1980-1984.

TABLE 44. Semi-monthly set and drift net harvest estimates of steelhead trout captured in the three Klamath River monitoring areas of the Hoopa Valley Reservation in 1984.

Time Period	NET HARVEST MONITORING AREA					Semi-Monthly Totals (All Areas)	Cumulative Seasonal Total
	Estuary	Middle Klamath Set Net	Middle Klamath Drift Net	Upper Klamath Set Net	Upper Klamath Drift Net		
July 16 - 31	68 1/ 10 2/ 14.7% 3/ 29 4/	- - - -	- - - -	- - - -	- - - -	68	68
August 1 - 15	60 7 11.7% 28	31 4 12.9% 14	15 3 20.0% 3	12 3 25% 2	0 - - -	118	186
August 16 - 31	43 5 11.6% 23	27 5 18.5% 9	6 1 16.7% 7	22 2 9.1% 11	0 - - -	98	284
September 1 - 15	28 3 10.7% 15	51 7 13.7% 26	29 4 13.8% 11	26 3 11.5% 18	26 5 19.2% 12	160	444
September 16 - 30	5 1 20.0% 2	17 3 17.6% 6	0 - - -	5 2 40.0% 4	73 13 17.8% 16	100	544
October 1 - 15	- - - -	0 - - -	0 - - -	5 2 40.0% 1	7 1 14.3% 4	12	556
October 16 - 31	- - - -	- - - -	- - - -	26 7 26.9% 8	0 - - -	26	
Area Season Total	204 26 12.7% 97	126 19 15.1% 55	50 8 16.0% 21	96 19 19.8% 44	106 19 17.9% 32		582 91 15.6% 249

1/ Harvest estimate.
2/ 95% Confidence interval.
3/ Confidence interval percentage.
4/ Accounted number of steelhead trout.

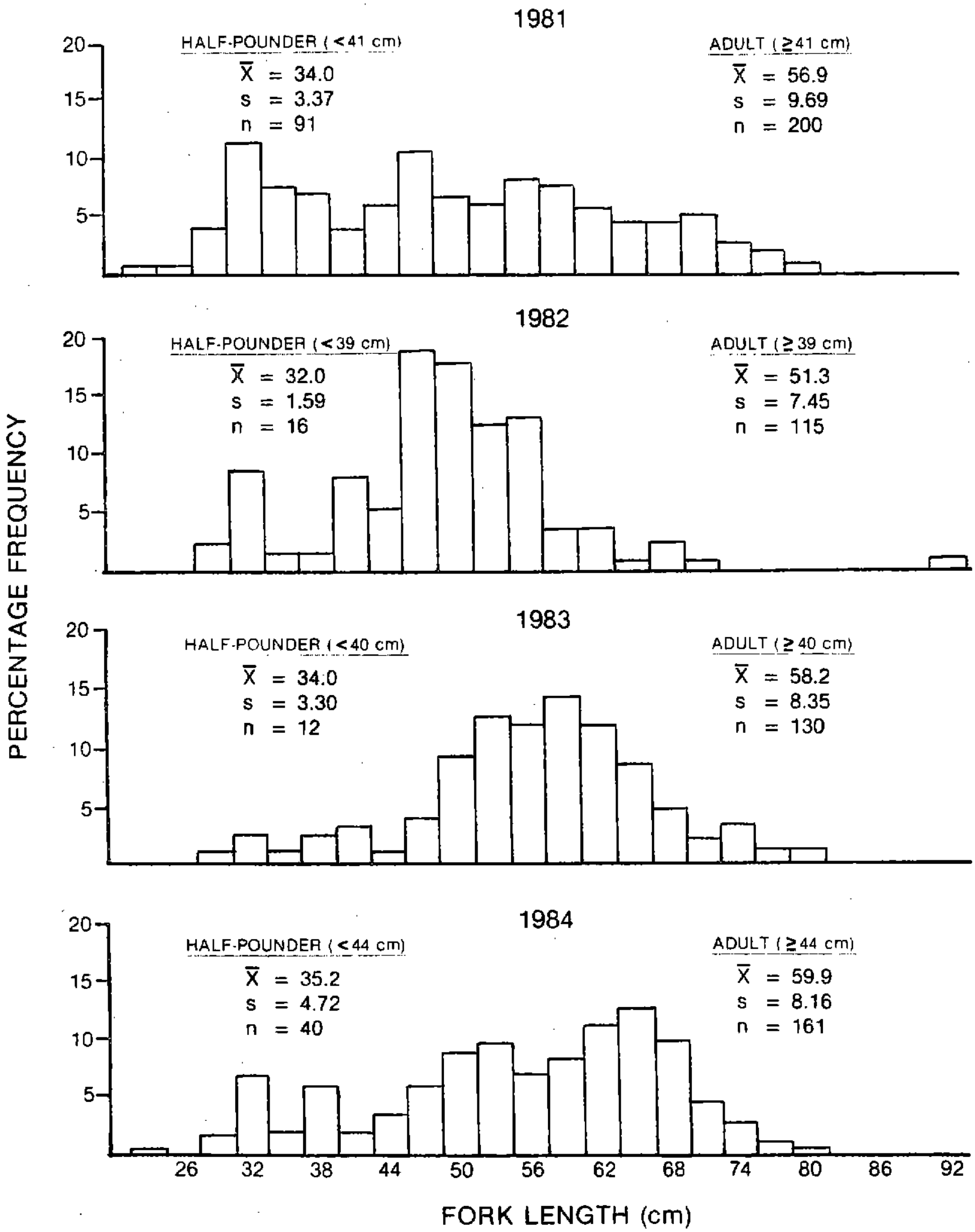


FIGURE 43. Length-frequency distributions of fall steelhead trout caught by Indian gill net fishers on the Klamath River portion of the Hoopa Valley Reservation during 1981-1984 (3 cm groupings with midpoints noted).

TABLE 45. Final harvest estimates of steelhead trout taken in the gill net fishery on the Hoopa Valley Reservation during 1980-1984 1/.

	FALL STEELHEAD TROUT		
Year	H-P	Adults	Total
1980	-	-	300 2/
1981	181	535	716 3/
1982	48	352	400 4/
1983	23	340	363 5/
1984	110	696	806 6/

1/ Estimates for 1983 and 1984 Trinity net fishery were obtained from Hoopa Valley Business Council, Fisheries Department.

2/ Estimation methods described in 1980 Annual Report.

3/ Estimation methods described in 1981 Annual Report.

4/ Estimation methods described in 1982 Annual Report.

5/ Estimation methods described in 1983 Annual Report.

6/ Estimation methods described in 1984 Annual Report.

STURGEON INVESTIGATIONS

ABSTRACT

A total of 8 green sturgeon, including 1 adult and 7 juveniles, were captured during 1984 beach seining operations in the Klamath River estuary. A total of 1 white and 75 green sturgeon (64 adults and 11 juveniles) were observed during 1984 net harvest monitoring program activities in the Klamath River portion of the Hoopa Valley Reservation. Green sturgeon observed in the two samples ranged from 21 to 214 cm total length. The single white sturgeon measured 109 cm total length. An estimated 2 white and 405 green sturgeon were harvested in the Indian gill net fishery on the Klamath River portion of the Hoopa Valley Reservation in 1984. Peak net harvest occurred during the April-July period during the annual upstream spawning migration.

STURGEON INVESTIGATIONS

INTRODUCTION

A sturgeon investigation program initiated by FAO-Arcata in 1979 to gather baseline data on population characteristics and harvest within the Klamath basin continued during 1984. Results of investigations during the period 1979-1983 were included in previous Annual Reports (USFWS 1982a, USFWS 1983, USFWS 1984). During 1984, as in previous years, green sturgeon (*Acipenser medirostris*) were far more numerous than white sturgeon (*A. transmontanus*) within the Klamath basin. Historical information indicates that green sturgeon have long outnumbered white sturgeon in the drainage.

METHODS

The majority of sturgeon sampling in 1984 occurred through previously described net harvest monitoring program activities conducted from April through October. Sturgeon were also sampled in 1984 through a beach seining program conducted near the mouth of the Klamath River.

Sturgeon net harvest estimates for 1984 were derived in a similar fashion to those for spring chinook. Methods used in monitoring the 1984 net fisheries during the spring and fall monitoring periods differed; both are discussed in detail in the chinook net harvest monitoring section of this report.

Whereas in previous seasons estimates of illegal harvest of sturgeon by snagging on the Hoopa Valley Reservation (HVR) were generated by this office, no such information is available for 1983 or 1984. Manpower levels available for spring field work precluded the collection of a sufficient amount of data to warrant generating such estimates. It is believed, however, that such harvest continues.

Sturgeon were identified to species by lateral scute count, measured and examined for any distinguishing marks or tags. When possible, sex and sexual maturity condition were noted. Biological data such as weight, fecundity, age determination, stomach content analysis and mark-recapture information were not collected in 1984 as baseline information from 1979-1982 appeared adequate to address these characteristics.

RESULTS AND DISCUSSION

Harvest

An estimated 2 white and 405 green sturgeon were harvested in the Hoopa Valley Reservation Indian gill net fishery between Weitchpec and the river mouth during 1984 (Table 46). As noted in previous sections of this report, coverage of gill net harvest by FAO-Arcata biologists during 1983-1984 no longer included the Trinity River portion of the Reservation as it had during 1980-1982. Estimates for the Trinity River in 1983-1984 were generated by the Hoopa Valley Business Council, Fisheries Department.

TABLE 46. Net harvest estimates for green and white sturgeon captured on the Klamath River portion of the Hoopa Valley Reservation in 1984.[1/]

	HARVEST PERIOD, SPECIES, AND RUN COMPONENT											
	April - July				August - October				Season			
	White		Green		White		Green		White		Green	
	Juv	Adult	Juv	Adult	Juv	Adult	Juv	Adult	Juv	Adult	Juv	Adult
Estuary	0	0	0	15	0	0	13	53	0	0	13	68
Middle Klamath	0	0	6	154	2	0	2	32	2	0	8	186
Upper Klamath	0	0	0	115	0	0	0	15	0	0	0	130
All Areas	0	0	6	284	2	0	15	100	2	0	21	384

1/ Estimates for gill net harvest on the Klamath River portion of the HVR only - no snag or sport harvest coverage, no Trinity River coverage for 1984.

TABLE 47. Harvest estimates for green and white sturgeon captured on the Hoopa Valley Reservation during 1980-1984.[1/]

		WHITE			GREEN		
		Juv	Adult	Total	Juv	Adult	Total
1980:	Gill Net	10	3	13	30	300	330
	Snag	0	2	2	0	400	400
	Total	10	5	15	30	700	730
1981:	Gill Net	10	5	15	25	810	835
	Snag	0	0	0	0	70	70
	Total	10	5	15	25	880	905
1982:	Gill Net	10	5	15	53	347	400
	Snag	0	0	0	5	50	55
	Total	10	5	15	58	397	455
1983:	Gill Net	10	0	10	89	406	495
1984:	Gill Net	2	0	2	21	394	415

1/ Total HVR estimates - include 1983-1984 Trinity River data provided by the HVBC, Fisheries Department.

All of the white and all of the immature green sturgeon were captured in the lower 10 km of the Klamath River, and may have been coastal migrant rather than spawning migrant. Some of these individuals may have originated from other river systems.

An estimated 384 adult green sturgeon were netted on the Klamath River portion of the HVR in 1984 with harvest of upstream migrants during the April-July period accounting for 74.0% of the total. Most of the adult green sturgeon netted during the August-October period were apparently downstream migrant post-spawners. The 1984 estimate of 384 adults is down 4.2% from the corresponding net harvest of 401 in 1983, up 17.4% from that of 327 adults in 1982, down 45.9% from that of 710 in 1981, and up 28.0% from that of 300 in 1980. No sturgeon harvest data is available for years prior to 1980. The 5-year average net harvest of adult green sturgeon between Weitchpec and the river mouth on the HVR is 424. Using 1984 data provided by the Hoopa Valley Business Council, Fisheries Department, the corresponding 5-year average net harvest of adults on the entire HVR is 451 (Table 47).

As noted, no estimates were generated during 1984 for illegal harvest of sturgeon on the HVR. Illegal snag harvest of green sturgeon below Coon Creek Falls has been a recurring problem since a debris slide created the migration obstacle in 1977. When the magnitude of the problem became apparent from observations of illegal activities in the area during the spring of 1980, FAO-Arcata staff recommended that a feasiblity study for debris removal be undertaken. After an on-site examination in May 1981, the in-river obstacle was blasted in a cooperative effort between the California Department of Fish and Game (CDFG), Bureau of Indian Affairs (BIA) and U.S. Fish and Wildlife Service (USFWS). Examinations of the site during 1982 indicated that these efforts were only partially successful in removing the debris. Moreover, high water conditions during the spring of 1982 made it difficult to assess exactly what the success of the blasting operation was. With even higher water conditions during the spring of 1983, it appeared necessary to observe the area during a normal- to low-flow year in order to accurately evaluate the success of the 1981 blasting operation. During 1984, an average- to low-water year, observations were again made at Coon Creek Falls during the spring sturgeon migration period. From these observations it became apparent that, while the 1981 blasting operation did alter the appearance of the falls to some extent, there appeared to be little if any change in the tendency of sturgeon to hold in the pool behind the falls. Coon Creek Falls therefore remains as the primary location on the Klamath River where sturgeon become highly concentrated, and are therefore subject to intense harvest pressures, both legal and illegal. It is during low flow years that sturgeon passage, and therefore harvest potential, becomes most critical at this site. Strict attention should continue to be paid to this area with an eye toward management of the sturgeon resource.

FAO-Arcata biologists observed no legal hook and line harvest of sturgeon on the HVR during 1984. The extent of the sport fishery for sturgeon in the Klamath basin is unknown.

Population Characteristics

As discussed, only limited biological data were collected on sturgeon observed in the Klamath River during 1984. Previous FAO-Arcata annual reports (USFWS 1981, USFWS 1982a, USFWS 1983) provide baseline data on population characteristics within the basin.

Total lengths were recorded for 1 white and 75 green sturgeon observed during harvest monitoring activities, and 8 green sturgeon captured during beach seining activities in 1984. The single white sturgeon examined measured 109 cm total length.

A total of 65 adult green sturgeon were examined, ranging from 140 cm to 214 cm total length with a mean of 175.0 cm (Figure 44). This mean is greater than that observed in the past two seasons and similar to the overall 5-year sample mean of 173.8 cm (Figure 45). Respective female and male 5-year known sex sample mean total lengths are 189.8 cm and 166.5 cm (Figure 46).

In 1984, as in 1979-1983, numerous coastal migrant, marine resident immature green sturgeon were encountered in the lower Klamath River. During 1984, these ranged from 40 cm to 118 cm total length, with a mean of 81.8 cm (Figure 47). All were observed during the months of July-September in the estuarine gill net fishery or the beach seine operation. Data from previous seasons indicate that abundance of immature green sturgeon peaks in the estuary during this time period. Potential impact on future green sturgeon populations levels from incidental harvest of juvenile sturgeon in the fall chinook net fishery during this time period should be carefully considered. An estimated 188 immature individuals were harvested during this period from 1981-1984. The gradual increase in mean length of juveniles observed in the sample from 52.8 cm in 1979 to 103.0 cm in 1983 may also indicate recruitment problems for the population during the past few years. Care should be taken to avoid over-harvest of this important species as time to recovery would be long for a population with such multiple age class composition.

A total of 4 outmigrant Klamath River green sturgeon were observed in the estuary during September 1984, ranging from 21 to 35 cm total length, with a mean of 27.3 cm. Strong outmigration (presumably indicating strong production) of green sturgeon from the Klamath River has not been observed since 1981, when 129 individuals were sampled in the estuary (river km 4.5) during September. Mean total length of outmigrants observed in 1981 was 30.7 cm, similar to the 1984 data presented.

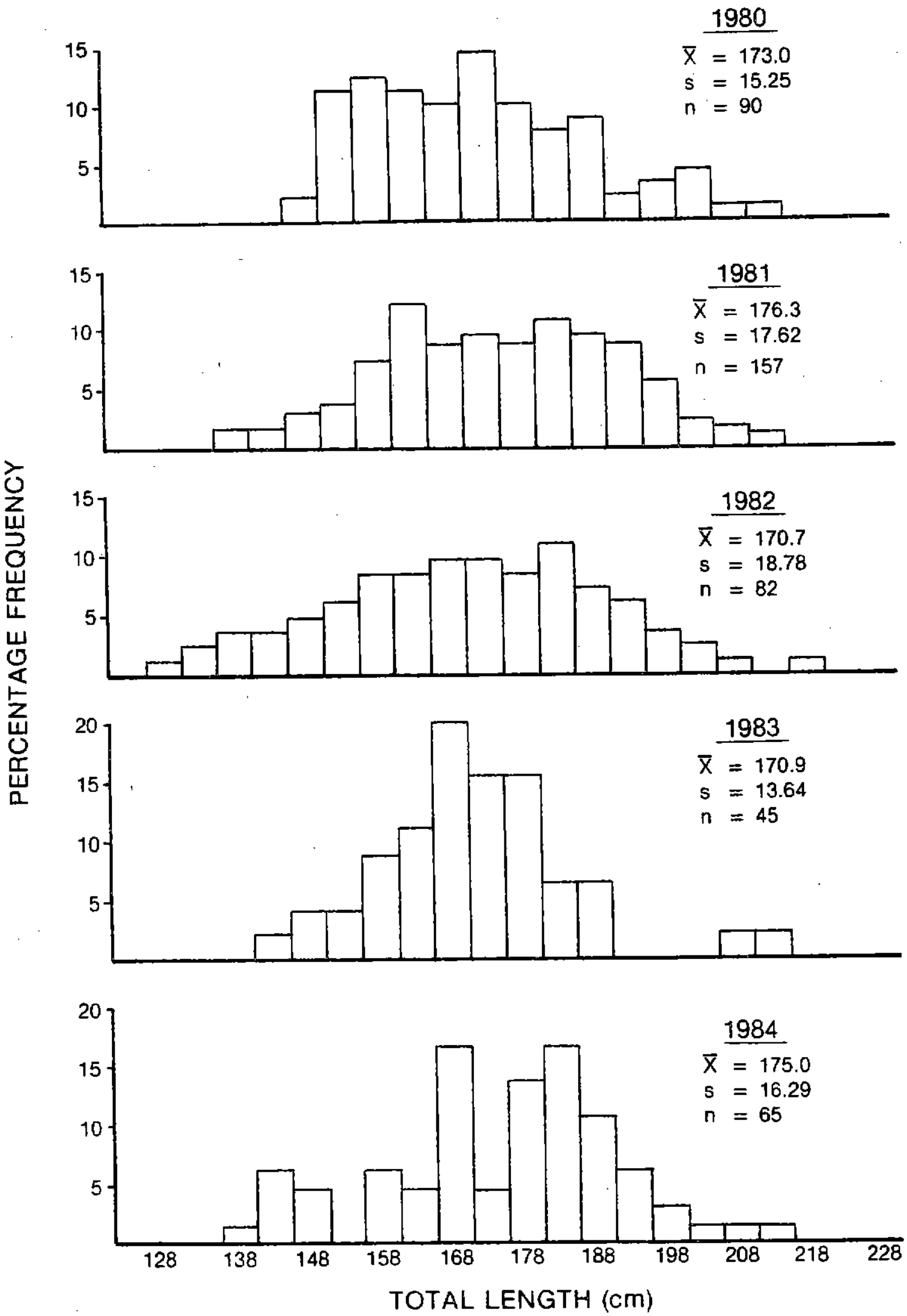


FIGURE 44. Length-frequency distributions of Klamath River adult green sturgeon captured by beach seine, gill net and hook and line during 1980-1984 (5 cm groupings with midpoints noted).

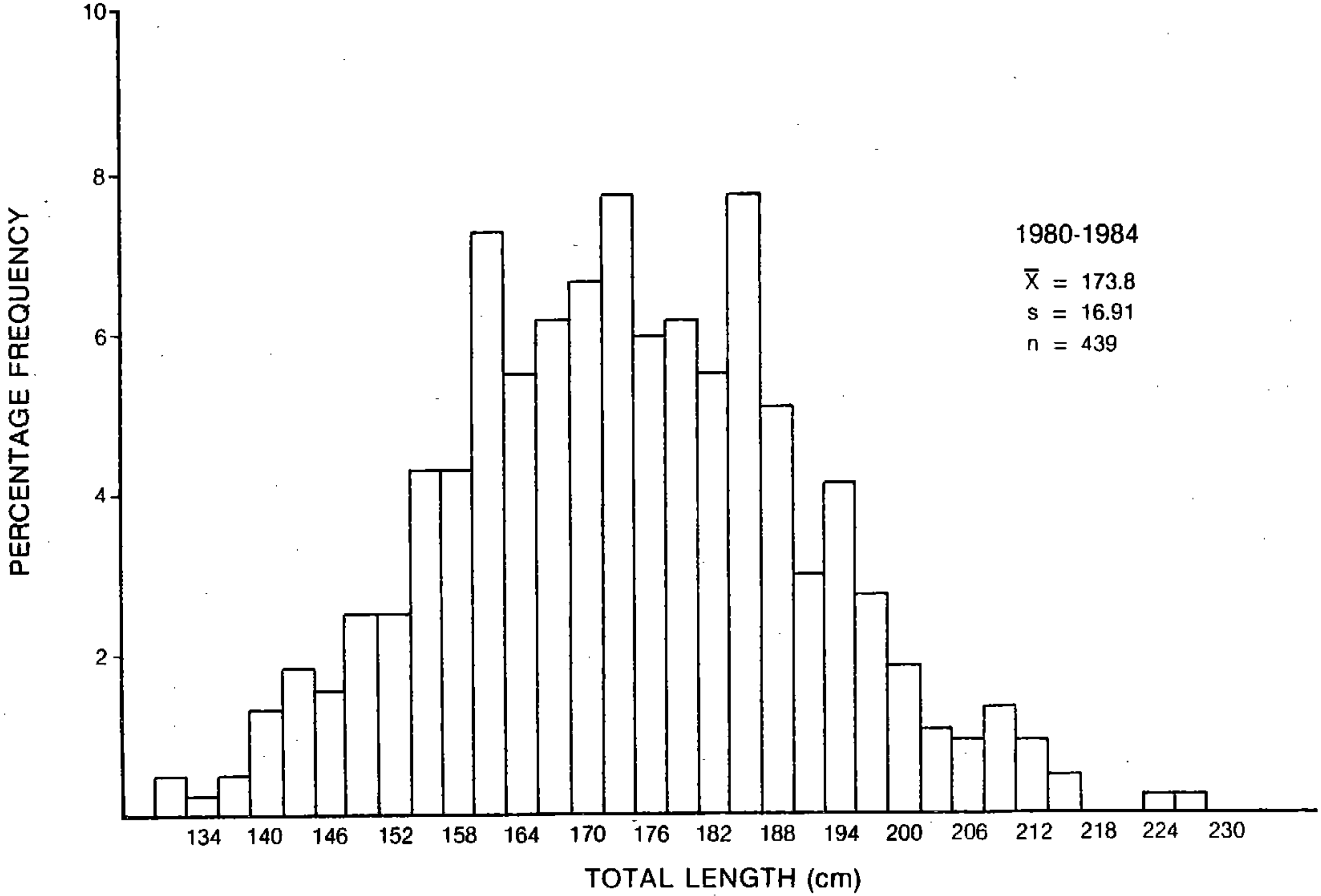


FIGURE 45. Combined length-frequency distribution of Klamath River adult green sturgeon captured by beach seine, gill net, and hook and line during 1980-1984 (5 cm groupings with midpoints noted).

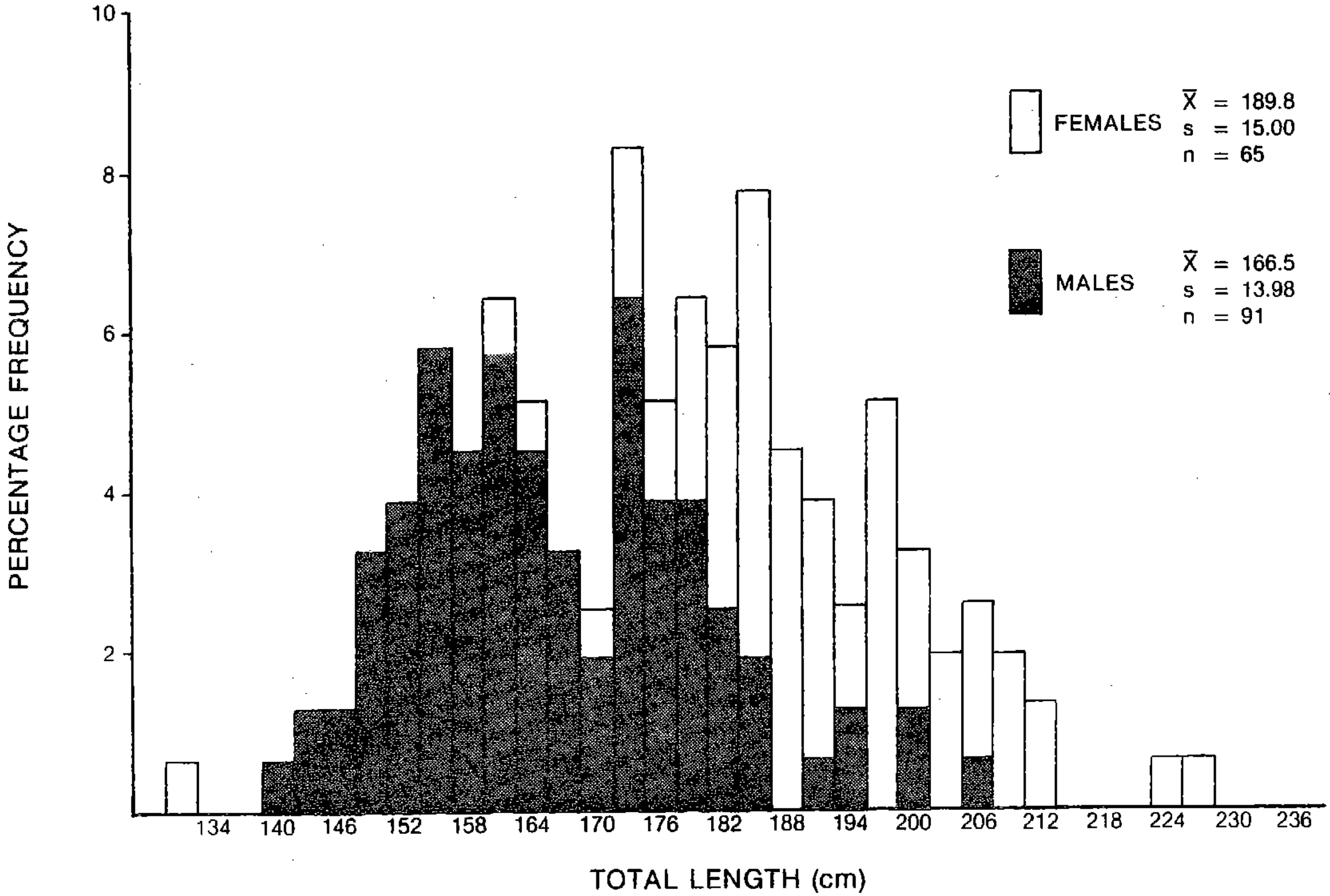


FIGURE 46. Combined length-frequency distribution of Klamath River adult male and female green sturgeon captured by beach seine, gill net, and hook and line during 1980-1984 (5 cm groupings with midpoints noted).

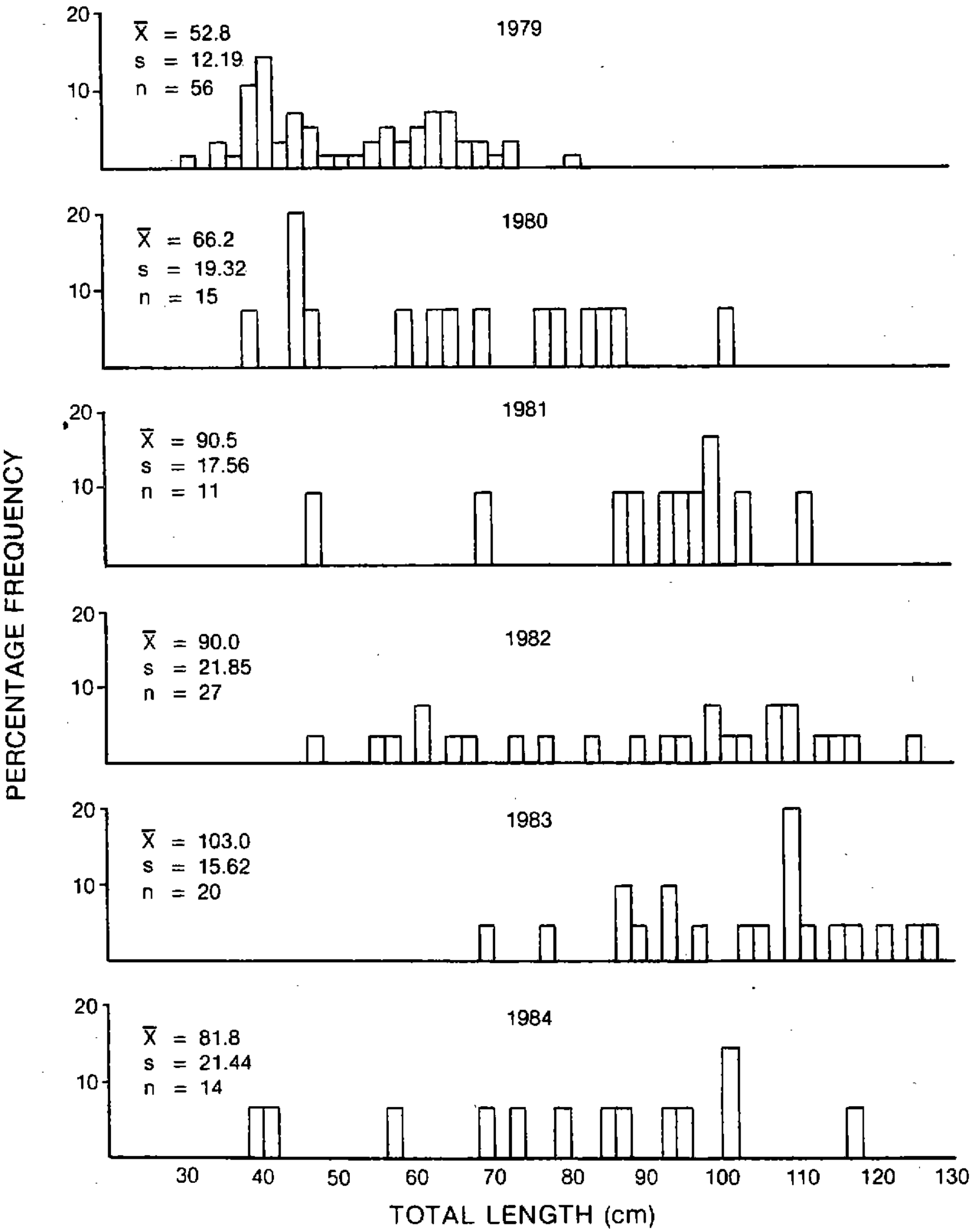


FIGURE 47. Length-frequency distributions of coastal migrant marine resident immature green sturgeon captured by beach seine and gill net in the Klamath River estuary during 1979-1984 (2 cm groupings).

PROGRAM PLANNING, DIRECTION, AND COORDINATION

INTRODUCTION

The course of the Klamath River Fisheries Investigation Program, and the role of FAO-Arcata in addressing resource-related issues involving the Klamath River basin, have evolved in response to Departmental direction through pertinent Memoranda of Understanding (MOU) and the Critical Issues Management System (CIMS), the USFWS Management By Objectives (MBO) program, and a variety of other Departmental and external factors. Further direction has been received through the preparation of a Regional Resource Plan by the USFWS Region One directorate (USFWS 1982b) and through a document entitled "Statement of Responsibilities and Role of the Fishery Resources Program (FRP)," which was approved by the Interior Department in March 1985. Bureau of Indian Affairs (BIA) planning processes involving fisheries resources of the Hoopa Valley Indian Reservation (HVR), including the Klamath River Basin Fisheries Resource Plan prepared under contract and released in February 1985 (USDI 1985), have and will continue to exert a strong influence on program direction. The passage of P.L. 98-541, the Trinity River Basin Fish and Wildlife Management Program, on October 24, 1984, may also exert an influence on program direction in the near future. Details of actions with potential relevance to FAO-Arcata programs have been presented in previous Annual Reports (USFWS 1982a, USFWS 1983, USFWS 1984), and no further discussion appears necessary at this time. The interested reader is referred to these documents for clarification on a myriad of internal and external factors influencing program direction.

LONG-TERM PLANNING

The various factors influencing the direction of the Klamath River Fisheries Investigation Program (KRFIP) are numerous and complex. Considering such complexity and with the currently prevailing climate of uncertain funding for FAO operations within the USFWS, long-term planning has become a difficult task. Still, future direction of office activities must be anticipated if goals and objectives are to be achieved. Alternative courses of action must also be considered in the eventuality of changes in funding levels or program direction received.

Certain priorities have been identified and are not expected to change radically in the near future. Anadromous fishes of the Klamath-Trinity basin have been identified as high priority and have been listed in order of preference for investment in restoration (USFWS 1982b). The KRFIP has and will continue to focus on five of these stocks: fall chinook, spring chinook, fall steelhead, coho salmon and green sturgeon. These have been recognized as fitting the criteria of being depressed stocks, largely of natural origin, with high value to fisheries and good restoration potential. FAO-Arcata biologists have also recommended to the BIA that current field programs be expanded to cover winter run steelhead trout.

For the priority species, FAO-Arcata programs will continue to center on: (1) collection of necessary baseline information on population characteristics, (2) monitoring of annual adult spawning migrations and juvenile populations and (3) monitoring of in-river net harvest levels. Such programs will be conducted in cooperation with other groups and agencies involved with the Klamath River fishery resource.

The KRFIP was initiated through the USFWS in 1977 at the request of the BIA in order to provide data necessary for management of the Klamath River fishery resource, in context of the expanding in-river net fishery. The USFWS was selected for program initiation because of the recognized expertise in fisheries management, there being no such capacity within the BIA or local Indian groups at that time. It should be recognized that at such time as fisheries expertise is developed among local Indians, or within the BIA, part or all of existing FAO-Arcata programs would be transferred to these groups. Such transfer of programs began with the establishment in 1981 of the Hoopa Valley Business Council (HVBC), Fisheries Department, and the hiring of two biologists by the Tribe. Former FAO-Arcata programs operating on the Trinity River under MOA with the BIA have now been entirely transferred to the HVBC. However, current office programs are considered of an on-going monitoring nature and are expected to continue within the USFWS, the BIA or local Indian groups as long as Department of the Interior or Indian-regulated fisheries are in operation on the Klamath River. With this in mind, a major aspect of FAO-Arcata operations has, and will continue to be, the training and education of local Native Americans in fisheries science. Specific directions anticipated for FAO-Arcata field activities in the near future are as follows:

(1) Beach Seining Operations are considered of a monitoring nature and should be continued on a yearly basis. Primary emphasis will remain with fall chinook. In-season fall chinook run strength indices derived from beach seine catch/effort data appear to have potential in management of the fisheries and research into their development and use should continue. Monitoring of fall chinook migration patterns within the basin by mark and recapture studies also appears useful in management and should continue. Collection of scales for age analysis of fall chinook provides critical information on this important species and should continue on a yearly basis. Because of the size selective nature of the gill net fishery, an unbiased scale sample cannot be taken from this source. Collection of data on a variety of other population characteristics is also seen as valuable and should continue through beach seining operations. It should be clearly understood that the beach seining and harvest monitoring programs together provide two key interactive components of the FAO-Arcata database. Elimination of either from the program would seriously impact the other as well as overall ability to address fishery problems in the basin. Both should be viewed as on-going monitoring programs to be continued indefinitely and not as baseline programs which will soon reach a point where necessary input has been supplied. The importance of data collected by these programs is substantiated by the use of same by the Pacific Fishery Management Council (PFMC) in analysis of the Klamath River fall chinook stock for management of ocean fisheries.

(2) Harvest Monitoring Operations provide the only presently available estimates of Indian gill net harvest within the Klamath River portion of the Hoopa Valley Reservation and collection of this

critical information should continue. Research begun in 1983 and 1984 into methods of improving the accuracy of harvest estimates and of generating estimates which can be placed within statistical confidence limits should continue. As discussed in the net harvest monitoring section of this report, a stratified random sampling methodology was for the first time employed in 1984 to derive the fall chinook net harvest estimates presented. The methodology also appeared promising toward providing accurate calculation of confidence intervals around the net harvest point estimated derived. However, although accurate point estimates were derived as a result of intensive field sampling undertaken, accurate calculation of sampling error and confidence intervals proved to be a more difficult task. FAO-Arcata biologists, in conjunction with statisticians from Humboldt State University, are working to develop an improved sampling methodology to address this problem prior to the 1985 season. The improved methodology is planned for expanded use in monitoring of all 1985 net fisheries covered. Research into data on size selectivity, the relationship between net harvest and river flow, models to predict net harvest and escapement associated with specific management options, and other management-oriented aspects of the fishery should continue. Collection of a variety of baseline biological data from the net harvest, including recaptures of fish tagged during beach seine operations, appears valuable and should continue. Recoveries of coded-wire tags (CWT) through monitoring of the net fishery is important to management of the fisheries and of hatchery stocks within the basin and should continue.

(3) Sturgeon Investigations during the 1979-1984 period have provided much needed baseline information on green sturgeon within the Klamath-Trinity basin. A comprehensive report on the first 6 years of sturgeon data collected by FAO-Arcata has been prepared and submitted to the California Fish and Game quarterly journal for publication. As requested by the BIA, study plans were also prepared in 1984 to address other questions concerning Klamath River green sturgeon which arose during the 1979-1984 baseline period. These questions concern definition of population levels occurring in the basin, location of spawning areas, migration behavior and assessment of juvenile production levels. Until funding is found for such work, FAO-Arcata efforts should continue toward documentation of net harvest levels occurring on the HVR.

(4) Juvenile Salmonid Investigations were discontinued after Fiscal Year 1982 due to lack of funding. Monitoring of juvenile populations of priority species in the basin, however, provides important information for management. At present, limited studies on juvenile populations are being conducted by the California Department of Fish and Game (CDFG) and the Hoopa Tribe in the basin, but information is still incomplete. Expansion of such studies would provide needed information on migration, production, growth, survival, hatchery-natural interactions and other characteristics of juvenile populations within the basin during 1984. It is recommended that such studies also be expanded through FAO-Arcata and/or other groups researching the Klamath.

(5) Other Programs are currently under consideration for potential inclusion in FAO-Arcata activities. As requested by the BIA under the Fiscal Year 1984 MOA, study proposals were prepared for investigation into harvest patterns and population characteristics of anadromous species not previously covered by the program, specifically winter run steelhead trout and Pacific lamprey. The BIA has also considered the funding of additional field work through FAO-Arcata for the purpose of involvement in the rapidly expanding stream enhancement and artificial propagation programs now occurring in the basin. No such funding was offered for fiscal year 1985. In addition, a proposal to study gill net size selectivity in the HVR fall chinook net fishery is being prepared for possible inclusion in FAO-Arcata activities during Fiscal Year 1986. The status of Fiscal Year 1986 funding for the various projects proposed is not known at the time of this writing.

(6) Program Planning, Direction and Coordination will remain essential and on-going parts of FAO-Arcata activities. Coordination of programs with and dissemination of information to other groups involved with the Klamath-Trinity fishery resource are recognized as high priorities. FAO-Arcata acquired data and word-processing equipment during 1984 to aid in streamlining analysis and transmittal of information collected through field programs, and to assist in the role of providing fisheries assistance.

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